ARCTIC

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URNAL OF THE ARCTIC INSTITUTE OF NORTH AMERICA

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Fig. 1. Looking down Adolf Hoels Gletscher, about 8 kilometres wide. Note the rough ice surface, partly cut by rivers. 23 August 1951.

JOURNEY ACROSS THE NUNATAKS OF CENTRAL EAST GREENLAND, 1951

H. R. Katz*

In the spring of 1951 plans were made by Lauge Koch's East Greenland Expedition for a summer crossing of the nunataks north of Petermanns Bjerg by a geological party. This region was chosen because large areas of ice-free country extend farther west than elsewhere in central east Greenland and, since the Caledonian mountain chain of the fjord zone trends northeastwards, it was hoped that new light would be thrown on the structure of the mountain belt. Between 72°N. and 74°N. this consists geologically of a crystalline band of gneisses and igneous rocks flanked to the east by non-metamorphic sediments of Late Precambrian and Early Paleozoic age and, nearer the coast, by younger sediments of Late Paleozoic and Mesozoic age. Early work in the Petermanns Bjerg region (Wordie, 1930) had shown that non-metamorphic sediments occur also in this area, and this had later been interpreted as indicating that a belt of these sediments extended to the west of the crystalline rocks and was therefore part of the foreland west of the belt of Caledonian folding (Wegmann, 1935; Koch, 1936).

Previous attempts at exploring the high mountain regions along the ice cap had shown that it would be exceedingly difficult to carry sufficient supplies for a journey lasting one month from a base in the fjords. In this region the large glaciers are heavily crevassed and cannot be used as routes by expeditions interested in other work than ice climbing. In 1948 W. Huber and I (Huber, 1950) had tried to travel westwards along the large Jætte Gletscher from a base camp near Gregorys Gletscher, northeast of Petermanns Bjerg, but we had failed. It became obvious that to make our planned journey across the inland nunataks we must either find a place where the first 1,700 metres above the sea could be climbed without difficulty, or arrange for supplies to be dropped by aircraft for a sledge party.

During the early spring of 1949 I had found that it was possible to reach a relatively flat glacier plain, only 1,000 metres above sea level, just north of the head of Geologfjord, Strindbergs Land, and that this appeared to lead westwards into the broad valley of Adolf Hoels Gletscher. In 1931 the Norwegians Høygaard and Mehren (1932) had followed part of this route in the opposite direction on their west to east crossing of the ice cap. They had travelled down Waltershausen Gletscher to Nordfjord, but from their reports they must have had unusually favourable conditions. Our first plan was to follow the route up Geologfjord westwards and cross northeast Strindbergs Land to the flat glacier plain, thus avoiding the highly crevassed surface

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Fig. 2. Weasel tracks on the ice cap after snowfall. 1 August 1951.

of Waltershausen Gletscher or of the even more difficult Nunatak Gletscher. This route would be much easier and shorter than that travelled by Høygaard and Mehren, moreover there was a large lake at an altitude of 750 metres where we hoped our Norseman aircraft would be able to land.

Fortunately, we were able to improve our plans very considerably as M. Paul-Emile Victor, whose expedition had worked for three successive years on the Greenland ice cap, and the Danish Government kindly offered to give us the most effective support they could. Victor had crossed the ice cap during 1950 with one of his mechanized groups using "weasels" and had reached Cecilia Nunatak, an easy journey from Ella Ø radio station on the east coast.

We therefore decided to make a combined expedition. A party from the French expedition would meet our group at Cecilia Nunatak to help us carry our heavy equipment which would be dropped, together with additional fuel for the weasels, near the French camp by a DC 4-Skymaster from Iceland. Our group would fly by Norseman aircraft to the head of Röhss Fjord, from where it was a comparatively easy climb to the top of Cecilia Nunatak, 1,600 metres high. From Cecilia Nunatak we would travel with the weasels of the French expedition westwards and northwards over the ice cap to the best place to start our way eastwards. Walking on skis and pulling light Nansen sledges we would then travel along the large glaciers coming down from the ice cap, thus crossing the nunataks and mountains, until we reached the area

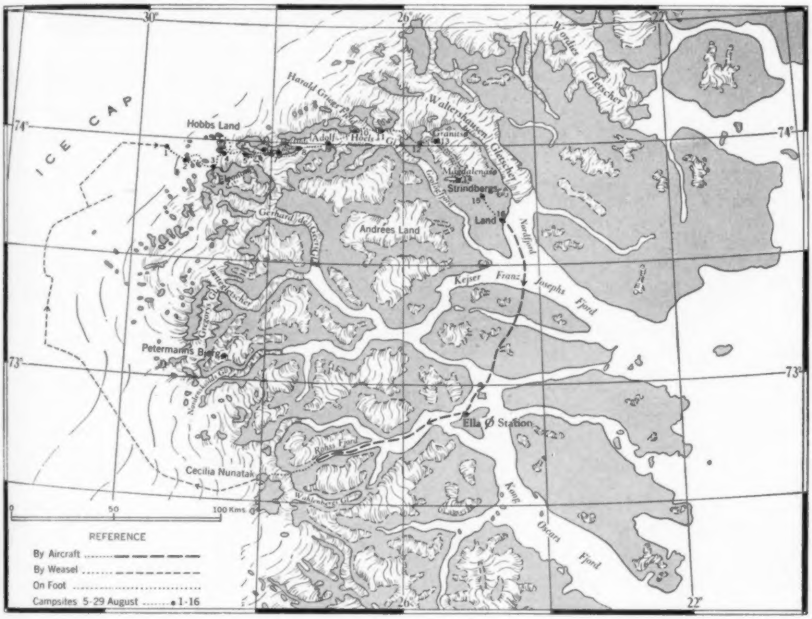

Fig. 3. Sketch-map of central east Greenland showing the route of the expedition.

north of Geologfjord, where we would be picked up by a Norseman aircraft from our expedition.

Compared with earlier journeys in east Greenland our combined party was an experiment and there was little experience to guide us. Our main purpose was to carry out as detailed geological investigations as possible, and we had to plan our crossing of the nunatak region accordingly. Our party consisted of W. Diehl, H. Röthlisberger, and myself as leader. Diehl and Röthlisberger are both most able mountaineers, and the latter had had some arctic experience as a member of the Arctic Institute's 1950 Baffin Island Expedition.[1]

Unfavourable weather and ice conditions delayed our start from Ella Ø until July 29. We reached Cecilia Nunatak two days later, where we met the weasel party according to plan. We found that the parachute drop had already taken place, and we were able to start westwards with them on the evening of August 1 (Fig. 2). During the following days we made several attempts to cross the broad border zone of the ice cap and to reach the lower region of the nunataks (towards the north we followed a route between 2,500 and 2,800 metres in altitude), but the weasels always broke through the snow bridges which covered the large crevasses. We were forced therefore to leave them behind on August 5, but we were now 300 kilometres on our way, though still 13 kilometres from the nearest nunatak, a small, rocky outcrop.

[1]See *Arctic,* Vol. 3 (1950) pp. 131–49.

Fig. 4. Nunataks at the edge of the ice cap, passed when travelling on skis towards the main glaciers. 8 August 1951.

Thanks to the assistance of the French weasel party led by G. Rouillon, we had reached the westernmost point of our journey still well equipped and fully supplied. The French party then had to make its way back to the Central Station and the west coast, while we hoped to be able to walk through Hobbs Land, Harald Griegs Fjeld, and Adolf Hoels Gletscher to Strindbergs Land within the next three to four weeks.

We had planned to abandon our equipment as soon as it was of no further use. Thus we left our skis at Camp 6, at about 1,500 metres, as from there on we were travelling on bare ice, and on August 18 we left one of the two sledges, already badly damaged, as well as a tent, some clothes, and food at Camp 7, as every kilometre seemed to be getting more difficult. Two days later we had to abandon the remaining sledge and to carry our supplies, including many rock samples, as the extremely hummocky ice became too difficult for sledging.

We reached the northernmost part of Strindbergs Land on August 25, where we had to cross a rather large river draining Granitsø. We were disappointed to find that the lake was already covered with thin new ice, besides carrying some icebergs, as we had hoped that our aircraft might be able to land there. Fortunately we could live from hunting—a fact we had taken into account in our plans—as we had practically no food left. On the morning of August 27 we used the last of our fuel and so set out for Magdalenasø, about 25 kilometres away, where our Norseman aircraft should have

Fig. 5. Edge of the ice cap seen from the top of one of the nunataks. 6 August 1951.

left a cache for us some two weeks previously. However, finding no cache we waited for 24 hours and then, as we had no food left, we started to walk the remaining 30 kilometres to Nordfjord where we assumed that supplies, including coal, had been left in a small cabin which I had made my base during the winter of 1948–9. This proved a happy decision, and one of the expedition's Norseman aircraft found us in Nordfjord on the evening of August 29 and took us to Ella Ø.

Thus the round journey from Ella Ø and back was completed within thirty-one days. The travelling distance across the mountain range, that is from our camp 1 at the edge of the ice cap (August 5) eastwards to Nordfjord (August 29), was about 220 kilometres, while at the same time we covered about another 160 kilometres on geological and reconnaissance trips and the weasels had taken us 300 kilometres across the ice cap.

In general our journey was as successful as we could have hoped, and resulted in our getting a rather extensive knowledge of the geology of the innermost region near the ice cap. It was also shown that a small, experienced party of relatively little cost can move and work everywhere, even in the inland areas of mountains and ice, providing it is well organized and efficiently supplied. Besides geology, which was our main task, we made fairly detailed sketch-maps, and studied the glaciology, botany, and zoology of the area when time permitted. Most of the scientific results, including a map showing the principal glaciers between 72°N. and 74°30N. as well as a detailed geological

map and profiles, have been published (in German) in *Meddelelser om Grønland* (Katz, 1952a). The following account briefly describes the main results of the expedition.

Climate and ice conditions

Compared with normal arctic practice, we appeared to be making a rather late start leaving in August. We had planned, however, to start approximately two weeks earlier, but weather conditions on the ice cap as well as ice conditions along the east coast had proved to be exceptionally bad during June to July, so that the progress of the French party (Victor, 1953) and our flight from Iceland were delayed. In fact, this proved to be most fortunate, because inland all lakes and streams formed by meltwater on the glaciers during the summer had refrozen. Only in the very last days, at an altitude of 1,100 metres or less, were we troubled by rivers still flowing under a thin sheet of ice, whereas as late as the end of July on our journey to Cecilia Nunatak we had been much hindered by melting effects when crossing Wahlenbergs Gletscher at 1,400 metres. Here we had to wade across deep rivers, partly in gorges, and continually broke through the rough ice surface into small holes filled with meltwater—each time with one leg only, which is extremely tiring on a long walk when carrying heavy loads. These holes, known as cryoconite holes, vary from a few centimetres up to half a metre in diameter and are as deep as a man's leg. They are produced by dark sand and stones melting down through the ice surface during the summer, and are a very common feature in this region.

On our journey over the ice cap with the French expedition we gained a good idea of the region to the west of the glacier system which produces most icebergs on the east coast north of Scoresby Sund. We found that the crevassed area at the edge of the ice cap extended much farther westwards than we had expected, and to an altitude of more than 2,600 metres. Throughout the entire distance from 72°30N. to 74°N. a large barrier of extensively crevassed terraces, icy slopes, and hills falling in steps towards the nunataks lay to the east of our route. On skis however, we found that we could cross it without too much difficulty.

On the ice cap the temperatures during the first days of August were mostly between –17° and –25°C (+1° and –13°F), sometimes as low as –30°C (–22°F). When approaching the nunataks it became noticeably warmer, which was mainly due to radiation from the bare rock; this warming effect was also apparent in the mountainous area at the same altitude as the ice cap (2,400 metres) if there was a sufficient area of exposed rock.

Later, in August, when travelling along the lower broad glacier valleys, the mean temperature was still well below freezing, –15° to –5°C. Although there were signs that a few weeks earlier there had been many lakes and flowing rivers on the glaciers as well as on the land, the larger lakes, mostly edging the glaciers, had never entirely thawed during the summer. At less than 1,500 metres altitude we found that on Eleonores Sø (Fig. 10), 1.5 to

Fig. 6. Looking southwest from Harald Griegs Fjeld over one of the main glaciers which cuts the whole nunatak region. Ice surface in the centre is about 1,400 metres in altitude. Distance to the mountains in centre background is approximately 24 kilometres. 19 August 1951.

Fig. 7. Frozen river in gorge north of Strindbergs Land. 25 August 1951.

Fig. 8. River disappearing in 40-foot deep gorge, Adolf Hoels Gletscher after snowfall. 22 August 1951.

2 kilometres in diameter, only a strip 10 to 30 metres wide along the stony shore had thawed that year, and as early as August 12 this had refrozen to a depth of 20 centimetres.

We had expected to find a warmer climate, and the temperatures reported by Høygaard and Mehren in 1931 had been much higher than on our trip. The very low precipitation during the month of August was much the same as that found in all central and northern parts of east Greenland, which is almost a subdesert. We had some snow on August 1, cloudy and misty weather on the evening of August 4 and on August 7 and 15, and two further days of bad weather with snowfall and fog on August 20 and 21; on all other days there was bright sunshine, but generally with heavy winds from the west.

These winds are usual along the edge of the ice cap, because of the difference in pressure over the ice cap and off the coast, and their strength when funnelled in the fjords is well known; there they often cause a sudden and very large rise in temperature, especially during the winter. Because of the strong winds most of the snow was packed hard, dunes were formed, and quantities of drifting snow were transported eastwards, whitening the rocky slopes of the nunataks up to a height of 50 to 100 metres above the surrounding ice surface.

On the large glaciers the lower limit of permanent snow cover was about 1,700–1,800 metres, some 2–300 metres higher than on the local glaciers in the fjord zone. At the edge of the ice cap, however, steep slopes of pure, dense glacier ice were occasionally found at altitudes up to 2,300 metres.

The glaciers themselves are seemingly filling up the main valleys with a very thick mass of ice. Visible moraines are rather scarce and limited to small side tongues running into remarkable depressions, a common feature along our route. The surface of the main glaciers, which are some 5–7 kilometres broad and move rather fast, is often much higher than the neighbouring ice-free areas. As these areas are surrounded by mountains they form a kind of tributary basin with the narrow mouth towards the glacier-filled main valley (Fig. 9). In these depressions fairly large lakes are often dammed up by the side glacier tongues. We saw no streams leading from these lakes, and the equilibrium–if any exists–must be kept by evaporation, which would be quite possible as there is much evidence of the dryness of the local climate. The side glacier tongues running to the depressions are moving steadily, yet they melt away as fast as they move owing to the warmth from the great radiation from the surrounding bare rock slopes. Moraine hills burying dead ice and moraine lakes are characteristic of such depressions. Even at altitudes of 1,500 metres, where under normal circumstances the large glaciers are little affected by ablation and melting, a considerable loss of ice must result from such side tongues.

Geology

The route we followed from the westernmost nunataks to Strindbergs Land cut the trend of the mountain belt almost at right angles, thus providing us with an ideal geological cross-section. Moreover, the outcrops in general

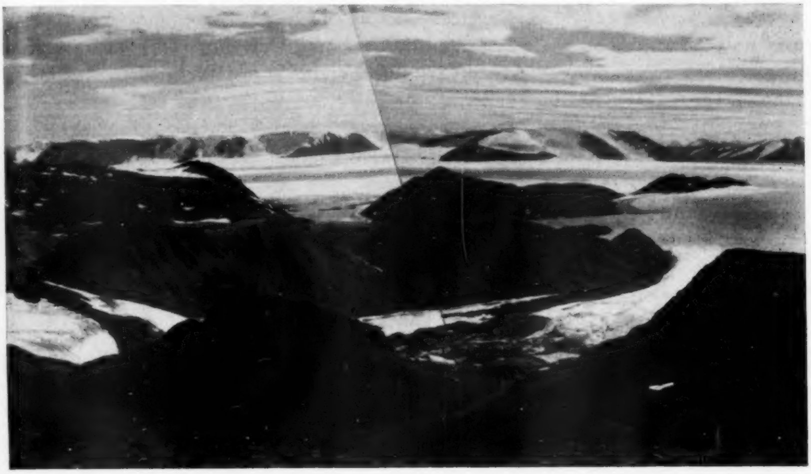

Fig. 9. Part of sedimentary area west of Harald Griegs Fjeld, looking south. Dead ice with moraines and lakes in depression, centre foreground. 17 August 1951.

Fig. 10. Carrying sledges and supplies across a small, rocky pass to another glacier at Eleonores Sø. The lake is entirely surrounded by non-metamorphic sediments. A layer of black basalt may be seen in right background. 15 August 1951.

are well exposed and almost continuous, especially in the mountain chains to the north of our route, so that we could obtain a rather complete picture of the geological structure. As the structural trend is north–south to northeast–southwest we are dealing here, tectonically, with the westernmost exposed parts of the orogenic belt in central east Greenland; at least between 72°N. and 76°N. there are only some very fragmentary outcrops just south of our region which are as far west.

We found that the Caledonian orogenic belt extends westward, beyond the area examined. Tectonic disturbances were of even greater intensity in some parts of the area than in the fjord zone. Further, the effects of Caledonian metamorphism were observed almost everywhere; though small areas of less metamorphosed rocks and even of entirely unaltered sediments were found. Quartzites of various metamorphic grades predominate in the westernmost nunataks, whereas towards the east the rocks are mainly gneisses, mica-schists, amphibolites, and strongly altered quartzites. No continuation of the Petermann Peak Sedimentary Series (Wordie, 1930; Huber, 1950) was found, as some 50 kilometres north of the mountain the core of the folded belt is exposed again, and the effects of intense metamorphism can be observed as well as large granitic intrusions.

Another sedimentary area, however, was found on our journey in the region near Eleonores Sø, Arnold Eschers Land[1], about 74°N., 28°W. (Figs. 9, 10, and 11). It consists of sandy and limey slates, argillaceous shales, dolomites, and limestones with breccias. These rocks are of the same type as those of the Eleonore Bay Formation of the fjord zone, and were deposited in a similar lithological succession. They are therefore considered to be the same age, i.e. Late Precambrian. Tillites, found in the east, were not deposited on these strata; instead there is a thick mass of slightly altered greenstones (chlorite-albite-schists and actinolite-epidote-schists with actinolite-marbles) partly cut by porphyries. Contact phenomena against the underlying strata appear to exist, so that these rocks must have originated from a kind of ophiolitic intrusion (Katz, 1952a, p. 47). The tillites, laid down along the eastern shelf of the old trough, which are in the same stratigraphic position as the greenstones, are frequently intermingled with tuffitic material (Katz, 1952b). It is concluded therefore that not only great tectonic movements, but also strong magmatic activity occurred in some place during Late Precambrian times. Other parts of the trough, however, continued to be undisturbed areas of marine sedimentation until the Early Paleozoic. In these areas the Late Precambrian as well as the overlying Cambrian and Ordovician strata were affected as one single mass by the Caledonian orogeny.

In general it has been found in several places throughout the broad Caledonian belt of east Greenland, where the greater part of the rock formations are strongly metamorphosed, that bodies of non-metamorphic rocks exist. These represent remnants of the original sedimentary series deposited from Late Precambrian to Ordovician times. The best known and

[1] In a previous paper (Katz, 1952b) I erroneously referred to "Alfred Eschers Land". This area was named for the former Professor of Geology at Zürich (1952b, p. 28), and is correctly Arnold Eschers Land.

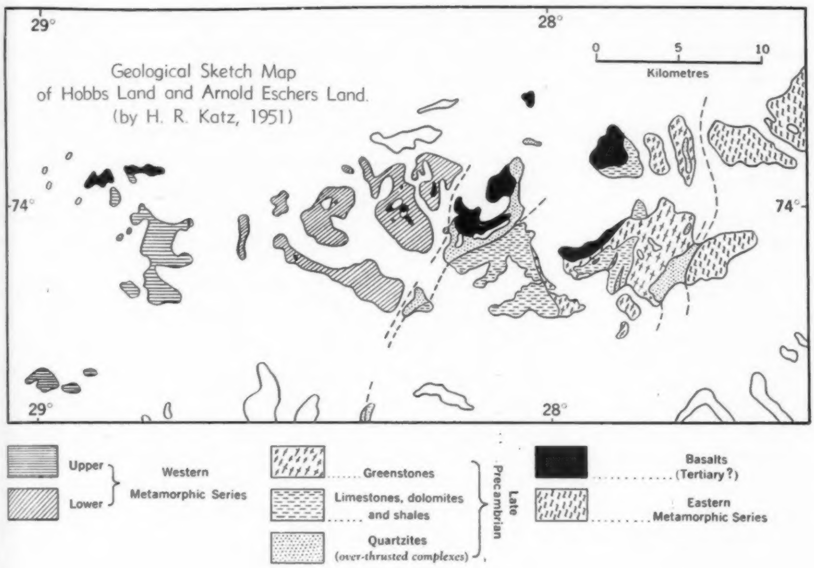

Fig. 11.

probably most extensive of these areas, where the effects of the orogeny have been comparatively slight—mainly some folding and faulting—is in the fjord region. As the greater part of Strindbergs Land falls within this region the geological cross-section made along our route shows the relationship between the western sedimentary areas and the fjord region.

Thus, the local non-metamorphosed area found on our journey shows that during the Late Precambrian the trough must have been much deeper in the west than in the shallow shelf zone of the fjords. The quartzites of Petermanns Bjerg do not therefore mark the western border of the geosyncline, as has formerly been assumed (Wegmann, 1935); neither are they of any regional importance, nor do they extend from far south to far north along the crystalline complex of the inner fjords of the region (Koch, 1936). They are a very local feature, and are merely one more remnant of the original sedimentary sequence. It is assumed that all this remnant series has been deposited in the same geosynclinal trough, and that it may all be correlated with the well-known Eleonore Bay Formation of the fjord region, or with parts of the Formation.

Superimposed on some tectonic features which are regarded here as Caledonian, are structures resulting from strong movements of later date. Especially west of Harald Griegs Fjeld, at about 28°W., some zones of complex overthrusting are believed to be of Devonian age; this movement is indicated both by the Upper Devonian tectonics in Strindbergs Land (Katz, 1952b) and farther east (Bütler, 1940), and also by the lithology of the thick Devonian Old Red sediments in the fjord region (Bütler, 1935).

At a later date our nunatak region was extensively eroded and was subsequently covered by a horizontal layer of basalt (partly nephelinites). This now lies at an altitude of more than 2,000 metres, and caps all mountains of that height for about 1,000 square kilometres. Its extension is probably much greater, as the basalt layer appears to continue northwards underneath the ice cap. Several basic and ultrabasic dykes and sills found in Hobbs Land (28°45W.) were apparently connected with the release of the large flow of lava, and they are very similar petrographically, as both contain phlogopite and nepheline. The basalt is tentatively assumed to be of Tertiary age.

In conclusion, our journey showed that in the westernmost parts of central east Greenland the geological features are also very complex, and that crustal movements must have occurred even up to the latest epochs. But the most important discovery was the knowledge that the Caledonian belt extends westward even beyond any outcrop that can be found; also, that during the Late Precambrian the geosynclinal trough had its central parts west of the present fjord region. Therefore it is unlikely that the western foreland of the Caledonian Geosyncline will be reached anywhere along the central part of the exposed mountain range, not even in Dronning Louises Land. Only in the northernmost area, towards Danmarks Fjord and Independence Fjord (80°N. to 82°N.), might this feature be found. Yet, although the orogenic belt in that region is probably very narrow and confined to the eastern part of Kronprins Christians Land, it is still possible that the undisturbed, horizontally-bedded sediments west of it (Koch, 1936; Troelsen, 1949) are not sediments formed on a western borderland but in the same geosynclinal trough. This is a question of great importance, but is far from being solved, and more detailed investigations are needed in that region. These investigations should also be of much assistance when a new survey is being made of north Greenland and of north Ellesmere Island.

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EDIBLE PLANTS OF THE ARCTIC†

A. E. Porsild*

Introduction

PLANTLIFE, everywhere in the Arctic, is too sparse, dwarfed, and poorly developed to make any considerable contribution to the food supply of man. Only a few arctic plants produce edible and nourishing roots or stems, and only near the southern fringe of the Barren Grounds are there some that regularly produce small, edible fruits. All plants, however, no matter where they grow, have some food value, and many, especially those that are green, are potential sources of vitamins, besides containing variable amounts of fat, protein, sugar, or starch.

Primitive man in the Arctic, however, has probably always been carnivorous, securing his food by hunting, fishing, or in some instances from domesticated animals, and only to a very small extent has he ever supplemented his food directly from the vegetable kingdom. Possibly he first came to use plants as food by accident, as a last resort when other sources of food failed him; perhaps he gradually developed a taste for some of the plants he had experimented with in this manner; or conceivably, he may have observed that some carnivorous animals, as for example, the polar bear, at certain times of the year "loosens its bowels by eating grass". Although he often starved when hunting and fishing failed, his food habits, from a dietary point of view, must always have been highly satisfactory, for not until he began to substitute "white man's" food for his own, did he begin to suffer from nutritional deficiencies.

Not so with white men living in the Arctic, for the narratives of many early arctic expeditions contain tragic accounts of ravages caused by scurvy; and even in recent times there are numerous instances when white men wintering in the Arctic have suffered, or even died, from lack of vitamins.

Different food habits are the cause of this. By preference arctic aborigines, whether by intuition or by experience, have always eaten the internal organs of animals that we now know have the highest vitamin content, whereas white men have generally disdained those parts of the animals, prefering instead the "choice" meaty cuts that make good roasts but contain little vitamin.

The recent investigations by Rodahl (1944) and others, of the vitamin content of arctic plants, have demonstrated too, that it is just those arctic plants that are eaten by preference by nearly all arctic tribes, that have the highest content of ascorbic acid as well as of thiamine, and that the methods of

†This paper was written for the *Encyclopedia Arctica* and is published with Dr. Stefansson's permission. The drawings were made by Dagny Tande Lid, Oslo, Norway.
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preparation and of storing of vegetable foods used by these people are perhaps the best possible in the circumstances for the preservation of vitamins.

Although in the aggregate, the amount of vegetable food used by arctic aborigines has always been small, they have, nevertheless, made use of a large number of different species. One factor limiting the amount they could use is that most arctic plants are available for a very short time only each year, and that primitive man in the Arctic has never learned to cultivate any species; nor has he learned to take advantage of the fact that many arctic plants respond to manure, as can be easily observed by their abundance and luxuriance near human habitation, bird cliffs, and animal burrows. This is perhaps not strange considering that most of these people are nomadic, and that, among primitive peoples, the gathering of roots and berries is the work of women and children. It is surprising that even the Chukchi, who make such extensive use of plants, have not learned to cultivate any species. Primitive man in the Arctic has, however, learned to gather and to store plant food for winter use, and to improve the palatability of some species by cooking, and even, if perhaps not at first intentionally, by a crude form of fermentation.

Among the Eskimo—the most widely distributed race of arctic aborigines—the dependence on vegetable food varies from group to group according to tradition and according to what plants are available in the area occupied by them; thus, to the most northerly tribes the use of vegetable food is purely incidental and largely limited to the partly fermented and pre-digested content of the rumen of caribou and muskoxen, whereas in the diet of the Eskimo of southwestern Greenland, Labrador, and western and southwestern Alaska, vegetable food constitutes a regular, if not very large, item. In northeastern Siberia, Kjellman (1882) noted that vegetable matter formed an important part of the food of the Chukchi. "Although the flesh of reindeer, seal, walrus, and bear, besides blood, blubber, fish, and other animal food forms the bulk of their diet, it cannot be denied, and must not be overlooked, that not only the nomadic reindeer Chukchi but also the hunting tribes living along the sea coast, utilize and have a definite taste for vegetable food. When available, vegetable food constitutes a regular part of at least their principal meals, and is eaten eagerly, and certain kinds even with avidity; furthermore, they consider these foods important enough each year to gather supplies that will last them through the long, grim winter".

In the matter of providence the Chukchi differ from the Eskimo, to whom the large scale gathering and storing of food is not a common or universal practice. Kjellman related that the inhabitants of Pitlekaj and the surrounding Chukchi villages, at the beginning of the winter of 1878, had accumulated stores of vegetables that were fully comparable with their stores of meat and blubber. So large, says Kjellman, were some of these stores that a reindeer Chukchi, whom he visited in March, still had on hand considerable quantities of vegetables that had been gathered in the course of the preceding summer and autumn. The collection of such large quantities of vegetables would entail an amount of planning and perseverance which is, indeed, unusual among arctic peoples.

W. Bogoras (1904) who, first as a member of Sibiryakoff's party and later of the Jesup North Pacific Expedition, spent many years among the Chukchi, has confirmed Kjellman's observations on the food habits of the Chukchi, but found that: "On the whole, vegetable food is much more used by women and children than by men" (p. 199).

The rather extensive use which the Chukchi make of vegetable food does not seem to be conditioned by local abundance of edible plants or by the lack of animal food. In physiography, as well as in flora and fauna, the Poluostrov Chukotski (Chukotsk Peninsula) is certainly comparable with northwestern Alaska where plant food plays a far less important role in the diet of the Eskimo. Kjellman thinks that the habit has been preserved from a time when the Chukchi lived farther south, in a climate more productive of vegetable matter.

It is of interest to note that, although native plants have never been extensively used by whites living in the Arctic, those eaten—mostly in emergencies—have generally been different species from those used by the aborigines, and, in the light of our present knowledge of vitamins, of lesser value. Thus there are numerous examples in the narratives of arctic expeditions of the uses made of lichens—especially "rock tripe" or "tripe-de-roche" of the early Canadian Voyageurs—besides mushrooms, puffballs, and scurvy grass (*Cochlearia*), none of which is ever eaten by aboriginal tribes. Likewise, berries such as the mountain cranberry or cowberry (*Vaccinium Vitis-Idaea*), bilberry or whortleberry (*Vaccinium uliginosum*), and to a lesser extent baked-apple (*Rubus Chamaemorus*) are perhaps among the most frequently and most readily used vegetable foods of white men living in the Arctic, whereas these fruits are generally ignored by aboriginal peoples who prefer the crowberry (*Empetrum*) which, in turn, is not favoured by whites.

The use and preparation of arctic food plants

Generally speaking no truly arctic plant is poisonous, nor are there known to be poisonous mushrooms, roots, or berries anywhere beyond the limit of trees, where, in fact, it is safe to eat any vegetable produce that appears at all edible. In the northern forest, on the other hand, there are a few plants that are definitely known to be poisonous. Those chiefly to be on guard against are the roots of water hemlock or musquash root, Fig. 7d, (*Cicuta* spp.), the fruits of red baneberry, Fig. 7a, b, c, (*Actaea rubra*), the death-cup toadstool (*Amanita phalloides*), and the almost equally poisonous fly amanita (*Amanita muscaria*). The latter, however, is in great demand among the Chukchi and other arctic tribes of eastern Siberia who chew the dried fungus as a narcotic or intoxicant (Bogoras, 1904).

At first glance, it might appear that the arctic aboriginal races use any plant, or any part of a plant that happens to be available, and is not too unpalatable. Such a conclusion, however, would be entirely erroneous. Thus, certain circumpolar species of plants are used by nearly all arctic tribes,

whereas other, and closely related ones, are not. Furthermore, an examination of the long list of plants used by Eskimo and Chukchi, shows that the preference for certain species is not dictated by local abundance. Kjellman (1882), for example, found that one of the principal food plants of the Chukchi was a certain willow, which was very common near the winter quarters of the *Vega* and supplied the bulk of the vegetable food collected. Other, and equally palatable plants, that to all intent and purpose were just as common and could have been collected without effort and in equal quantity, were completely ignored. In this connection it is of interest that Rodahl (1944) found that the ascorbic acid content of the leaves and buds of arctic willows exceed that of all other arctic plants examined by him.

Some plants, on the other hand, that were far less common and, on account of their scarcity and small size, had relatively small food value, were collected with an eagerness and perseverance that, in view of the general indolence of these people, astounded Kjellman. One such plant is *Polygonum viviparum*, which, according to the Chukchi must be collected immediately after the snow leaves the ground and before the first leaves appear. Only the rhizome, which is of the size of an unshelled peanut, is used; but to find and collect it in early spring certainly is no easy task. Nevertheless, even full-grown people, according to Kjellman, engaged in the collecting, and with surprisingly good results.

Kjellman noted that the flowering stems of the much less common, *Rhodiola rosea*, and especially the root tubers of the vetch, *Hedysarum obscurum*, were also considered choice and much favoured delicacies. As regards preparation of vegetable food, he found that only a few plants were consumed raw; the bulk were eaten boiled in soup cooked with meat or blood, and often after first having been made into a form of "sauerkraut". Roots, leaves, and stems of plants collected for winter use were tightly packed into sealskin bags, as a rule each kind by itself. In the process of storing such plants underwent some sort of fermentation. By their texture, smell, and taste Kjellman was able to recognize several kinds of "sauerkraut". One of them consisted entirely of the small twigs and leaves of *Salix kolymensis;* a second was composed largely of the leaves of *Petasites frigidus*, mixed with a variable quantity of leaves of *Saxifraga punctata*, leafy twigs of *Salix kolymensis*, the flowering axes of *Senecio congestus*, and leaves of *Oxyria digyna*; while a third consisted entirely of the succulent green leaves and stems of the knotweed, *Polygonum alaskanum* (*P. polymorphus*). Other forms of "sauerkraut" were prepared from the flowering stems of several species of fernweed (*Pedicularis* spp.) and from the leafy stems of seabeach sandwort (*Arenaria peploides*).

Although several kinds of berries grew in the region and were known to the Chukchi by name, Kjellman found that none was used to any great extent and that only crowberries (*Empetrum*) were eaten occasionally.

Among Eskimo the amount of plant food used varies from group to group but nowhere assumes the importance ascribed to it by Kjellman for the Chukchi. Thus Weyer (1932) estimated that in the diet of the Eskimo of the Bering Sea region vegetable food constituted no more than 5 per cent;

among the Central Canadian Eskimo Stefansson (1914) and Jenness (1928) noted that it was scarcely used at all; in Greenland the part played by vegetable food has always been unimportant, except from a dietary point of view.

Probably, in any particular group, the greatest use of plant food is today made by those who make the least use of imported "white man's" food; those who have easy access to trading posts very soon give up the practice of gathering native plant food and use increasing amounts of imported plant food in the form of flour, sugar, fats, preserved fruits, and jams. Among the more sophisticated Canadian Eskimo and Indians it is not uncommon to find an apologetic attitude, or even a certain amount of condescension, toward the less "enlightened" and "backward" among their countrymen who still maintain "native" customs and habits. Some years ago, while waiting for the arrival of the mail aircraft at a trading post on the lower Mackenzie River, I noted a large patch of wild raspberries "loaded" with excellent and fully ripe fruit. A group of native children were playing "hide and seek" among the raspberry canes but did not appear to pick the fruit. When commenting on this to the mother of one of the children I was told that "*she* bought raspberry jam for her children in the store, where there was lots".

In the use and preparation of plant food, Eskimo practices differ only slightly from those of the Chukchi, the chief difference being, perhaps, that more extensive use is made of berries, and that such roots, stems, and leaves of plants as are used, are not infrequently stored mixed with blubber. Although oil from the blubber may to some extent act as a preservative, some fermentation undoubtedly takes place as with the "sauerkraut" prepared by the Chukchi. Twenty-five years ago, I found that only a small number of plants was used by the Eskimo of northwestern Alaska. Among the more important were the leaves of *Saxifraga punctata*, the leaves and flowering axes of marsh-fleabane (*Senecio congestus*) and coltsfoot (*Petasites frigidus*), all of which were made into a form of "sauerkraut" mixed with blubber; the root tubers of Eskimo potato (*Claytonia tuberosa*) and those of the vetch (*Hedysarum alpinum*) were gathered in considerable quantities and used during the winter cooked as a vegetable with meat. Of the several kinds of berries used, cloudberry or baked-apple (*Rubus Chamaemorus*) and crowberry (*Empetrum*) were the most favoured. Both were eaten fresh or preserved frozen in sealskin bags.

In modern west Greenland only a few native plants are regularly eaten by the Greenlanders as seasonal delicacies, but from a dietary point of view they may, nevertheless, be of considerable importance. The more primitive east Greenlanders, on the other hand, make considerable use of plant food.

In the southern parts of east and west Greenland the *kvan* (*Angelica Archangelica*) is common along brooks, and in sheltered spots in the fiords may grow to a height of 6 feet. The tender, young leaf-stalks and flowering stems are considered a great delicacy and, when available, are eaten raw in great quantities. Because the *kvan* does not grow near the open sea coast, where most Greenland towns and villages are situated, and because this vegetable is in such great demand, long journeys are regularly undertaken

by the Greenlanders to obtain it. The *kvan* is equally relished by the Danish residents who generally eat it cooked and creamed.

Incidentally, the frequency with which the word *kuaneq* occurs in Eskimo place names antedating the present colonization of Greenland, shows that the Eskimo borrowed the Scandinavian word *kvan* from the language of the medieval Norse settlers of Greenland. Since the ancestors of the present Greenland Eskimo arrived in Greenland after the Norse, they could have had no previous knowledge of the *kvan*, and clearly adopted both the word and the eating of this plant from the Norse. This is of particular interest because it shows that some, at any rate, of the early Norse–Eskimo contacts were not hostile.

Of importance equal to that of the *kvan* is the crowberry (*Empetrum*), which is common everywhere in Greenland where it fruits abundantly at least to latitude 70°N. In 1857 Rink estimated that more than 1,000 barrels were consumed annually in southwest Greenland by the 6,100 Eskimo, and that during the autumn months, when the berries were ripe, they formed a regular part of the Greenlander's diet. The berries are either eaten fresh, when picked, or served with fresh and uncooked seal blubber. They keep well when frozen and in this state may be stored throughout the winter. In places where *Empetrum* is common, they may even be gathered under the snow. The frozen berries are scooped with a special scraper into a sieve made of sealskin, through which the snow, leaves, and other impurities are sifted.

The flowering stems of roseroot (*Rhodiola rosea*) and the fernweeds, *Pedicularis hirsuta* and *P. lanata*, find a limited use as potherbs. The mountain cranberry or cowberry (*Vaccinium Vitis-Idaea*) is of local occurrence in Greenland whereas the bilberry (*Vaccinium uliginosum*) has a distribution similar to that of the crowberry. While not favoured by the Greenlanders, both are in great demand by Danish residents. Several species of seaweed are eaten by Greenlanders and have recently been found to be an important source of ascorbic acid.

The fermented and half-digested content of caribou rumen, and also that of the muskox is considered a delicacy by all Eskimo who hunt these animals. This vegetable food is eaten raw or added to soup made from meat or blood. It is frequently preserved frozen for winter use. According to Bogoras (1904) the content of the reindeer rumen is eaten by the Chukchi and by other reindeer nomads of northeastern Siberia. In Greenland, where ptarmigan are hunted extensively for sale to Danish residents, the content of the crop is usually eaten at once by the hunter.

In the light of Rodahl's findings (1945) that the arctic willow and ground birch, both in summer and in winter, are rich sources of ascorbic acid, and that the latter also is an important source of thiamine, the dietary value of the content of both caribou rumen and ptarmigan crop is probably high. Although the bulk of the winter food of caribou and reindeer is lichen, twigs of willow and ground birch form a not inconsiderable addition, and these plants, summer and winter, are the principal source of food for both muskoxen and ptarmigan.

Some Common Edible Plants of the Arctic

Fruits and berries

In late summer several kinds of small fruits may be found in abundance, especially near the southern fringe of the Arctic. Without exception those found north of the limit of trees are edible and wholesome. Several kinds are not damaged, and many even be improved in flavour, by freezing. Some may be collected under the snow, or when the snow disappears in spring. In order of abundance and palatability the more important are as follows:

Black Crowberry or Curlewberry. *Empetrum nigrum.* Fig. 1h.

Depressed and matted, freely branching, evergreen shrub. Leaves linear, spreading, resembling those of spruce or juniper. The flowers are inconspicuous and solitary in the axils. The purplish black and shiny fruits are very juicy and sweet but contain a number of large hard seeds.

The crowberry is circumpolar and is found throughout the arctic regions, in eastern North America south to mountains of the New England States, in the west, south to California. It prefers sandy, rocky, and acid soils and reaches its perfection in a rather moist climate.

Because of its abundance and hardiness, the crowberry or curlewberry, although not as well-flavoured as some other berries, is easily the most important fruit of the arctic regions, and, apart from the cloudberry or baked-apple, is the only one regularly eaten by the natives of the Arctic. The berries are eaten when picked or stored frozen and eaten with seal blubber or oil. According to Rink (1857) a sparkling white wine may be produced by fermentation of the juice.

Cloudberry, Salmonberry, or Baked-Apple. *Rubus Chamaemorus.* Fig. 1i.

Herbaceous, low perennial from a creeping rootstock. Leaves round or kidney-shaped, five- to nine-lobed, stalked. Flowers solitary, terminal ½ to 1 inch broad, and white. The immature fruits are first reddish, then amber, and when fully ripe become pale yellow and very juicy. Sir John Richardson (1851, p. 293) aptly described them: "perhaps the most delicious of the arctic berries when in perfection, but cloys if eaten in quantity" whereas Fernald and Kinsey (1943, p. 236) praised them with less reserve saying: "The ripe, fresh berries of Baked-Apple eaten without sugar or cream are delicious, but with the addition of these dressings are positively luscious". The Eskimo, lacking such refinements, serve them in a mixture of seal oil and chewed caribou tallow which has been beaten to the consistency of whipped cream. This culinary treat in Alaska is known as "Eskimo ice cream".

Bilberry or Whortleberry. *Vaccinium uliginosum.* Fig. 1g.

Low, branching, erect, or decumbent shrub with small oval, deciduous leaves. Flowers small, urn-shaped, pale pink, in the leaf-axils. Berries, blue to black with a bloom, ripen early in August.

The bilberry is common throughout all arctic countries and, in the southern part of the Arctic usually produces an abundance of sweet, delicious

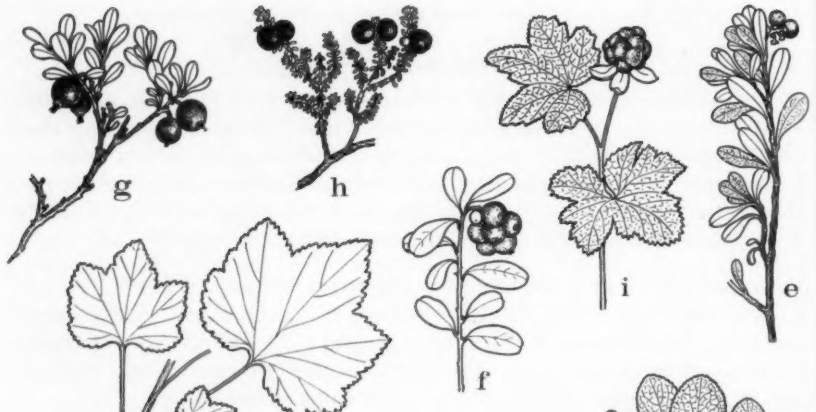

Fig. 1. Fruits and berries. a, Northern red currant (*Ribes triste*); b, c, Alpine bearberry (*Arctostaphylos alpina*); d, Red bearberry (*A. rubra*); e, Bearberry (*A. Uva-Ursi*); f, Mountain cranberry (*Vaccinium Vitis-Idaea*); g, Bilberry (*V. uliginosum*); h, Black crowberry (*Empetrum nigrum*); i, Baked-apple or cloudberry (*Rubus Chamaemorus*). X 2/5.

berries. It grows in acid soil in open places, and inhabits dry as well as moist places.

Although to the European palate of better flavour than the crowberry, the bilberry is not much esteemed by Eskimo who believe it is liable to cause dental decay.

Lingon, Mountain Cranberry, or Cowberry. *Vaccinium Vitis-Idaea.* Fig. 1f.

Low, creeping shrub with dark, leathery evergreen leaves. Flowers bell-shaped, white or pink, in small, nodding, terminal clusters. The shiny, dark red berries ripen in August and September, but remain on the vines throughout the winter, and the following spring, when the snow disappears, are sweeter, and even better than in the autumn.

The mountain cranberry is widely distributed throughout arctic countries occurring north at least to the arctic coast, but does not, as a rule, produce berries far north of the tree-line. It prefers acid soil and is found in moist as well as in dry, rocky places. It reaches its perfection, however, in open birch or willow thickets, where in some years the vines may be red with the fruit.

When gathered in the autumn the tart berries, if frozen, will keep until next spring. They are considered better flavoured than the southern true

cranberry, and are excellent for jams and jellies. A very refreshing beverage may be made from the diluted, sweetened juice.

Alpine and Red Bearberry. *Arctostaphylos alpina* and *A. rubra.* Fig. 1b,c,d.
Low, trailing shrubs with shreddy bark, and deciduous, obovate or oblanceolate, and finely serrated leaves. The flowers are small and appear in clusters toward the end of the branches in early spring before the leaves unfold. In *A. alpina* the berries are black and shiny; in *A. rubra* they are red, juicy but rather watery and insipid. Although eaten greedily by bears and ptarmigan, the berries are unattractive to most people, but, according to Fernald and Kinsey (1943, p. 310): "in the absence of more attractive berries this fruit is apparently wholesome and one soon acquires a taste for it".

Bearberry or *Kinnikinik.* *Arctostaphylos Uva-Ursi.* Fig. 1e.
Trailing evergreen shrub with small, bell-shaped, pink flowers in nodding, terminal clusters. The coral-red and somewhat mealy and dry berries are rather tasteless when raw, but quite palatable when cooked. The powdered dry leaves are occasionally used by natives as a substitute for tobacco, or mixed with it.

Northern Red Currant. *Ribes triste.* Fig. 1a.
The northern red currant occurs throughout the wooded parts of the Arctic but only extends a short distance into the Barren Grounds. The berries are almost indistinguishable from cultivated red currants in flavour and appearance; they ripen in August but last only a short time.

Potherbs

The leaves and flowering stems of a large number of arctic plants may be used in soups, as potherbs, pickled as "sauerkraut", or in salads. Descriptions, together with brief notes on their occurrences and uses, are given below.

Woolly Fernweed or Louse-wort. *Pedicularis lanata.* Fig. 2b,c.
Perennial herb with a well-developed tap root terminating in one or more dense rosettes of pinnately lobed leaves, that resemble the fronds of certain ferns; the leafy, 5- to 10-inch high flowering stem terminates in a dense, white, woolly spike of rose-pink, scented flowers. Toward maturity the stems elongate, and in winter often protrude through the snow. The root, which is lemon yellow and sweet, like young carrot, may be eaten raw or cooked; the flowering stem may be eaten boiled as a potherb. Eskimo children pick the flowers and suck the sweet nectar from the base of the long corolla tube.
The woolly fernweed is one of the earliest spring flowers on the arctic tundra. It is circumpolar and of arctic range.

Arctic Fernweed. *Pedicularis arctica.* Fig. 2a.
Similar, but with less woolly and more open spikes of pale, pink flowers. The root is pale yellow and more spindly. *Pedicularis arctica* is a North American species which ranges from northwestern Greenland to the north coast of Alaska.

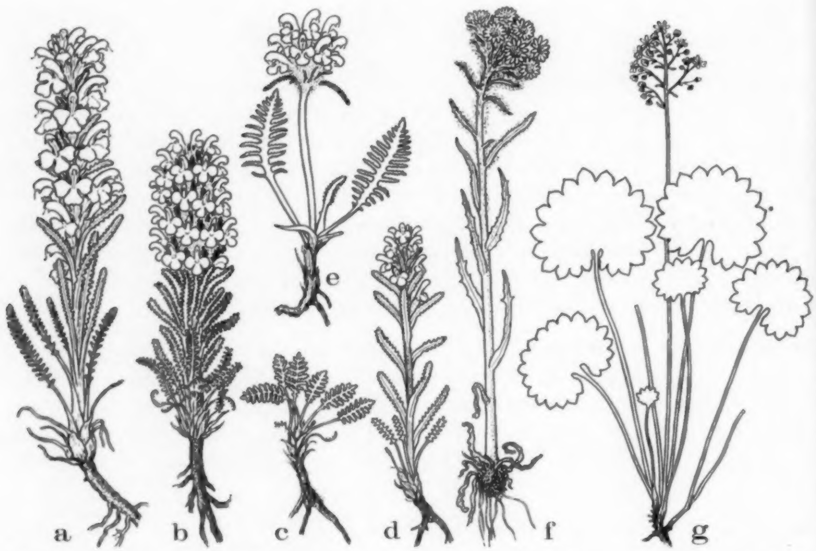

Fig. 2. Potherbs. a, Arctic fernweed (*Pedicularis arctica*); b, c, Woolly fernweed (*P. lanata*); d, Hairy fernweed (*P. hirsuta*); e, *P. sudetica*; f, Marsh-fleabane (*Senecio congestus*); g, Round-leaved saxifrage (*Saxifraga punctata*). X 2/5.

Hairy Fernweed. *Pedicularis hirsuta.* Fig. 2d.

Similar, with still paler flowers in a shorter spike. Like the preceding species, the hairy fernweed is of arctic or high arctic range, but limited to western Asia, Europe, Greenland, and the Eastern Canadian Arctic.

Fernweed. *Pedicularis sudetica.* Fig. 2e.

Circumpolar, glabrous perennial with dark-coloured leaves and stems, from a slender, freely branched rootstock. The flowers are dark red, in a dense spike which elongates as the seeds mature.

According to Kjellman the Chukchi prepare a "sauerkraut" from the flowering stems and eat the boiled rootstocks in soup.

Mountain Sorrel. *Oxyria digyna.* Fig. 3d.

Low and glabrous, somewhat fleshy perennial with erect, simple stems from a large, chaffy rootstock. Leaves are mostly basal, kidney-shaped in outline with from 1- to 2-inch wide blades on long, slender stalks. Flowers small, red or green, in a terminal plume-like raceme.

The mountain sorrel is a circumpolar, arctic–alpine species, ranging on the Barren Grounds from the north tip of Ellesmere Island south to the limit of trees, and in high mountains even south into California. It prefers somewhat shaded slopes and ravines, where snow accumulates during the winter and provides moisture that lasts throughout the growing season. In such places the fresh green leaves of the mountain sorrel may be found all summer. It

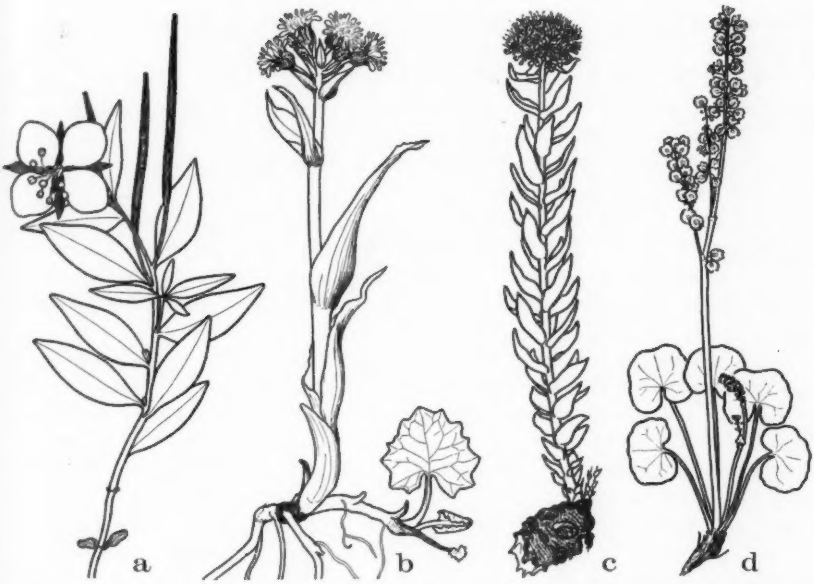

Fig. 3. Potherbs. a, Broad-leaved willow-herb (*Epilobium latifolium*); b, Northern sweet coltsfoot (*Petasites frigidus*); c, Roseroot (*Rhodiola rosea*); d, Mountain sorrel (*Oxyria digyna*). X 2/5.

responds wonderfully to manure, and in the rich soil under bird cliffs and near Eskimo dwellings may form large luxurious beds.

The succulent, juicy leaves and young stems are edible. When raw they are somewhat acid, but most refreshing and thirst-quenching; when cooked their flavour and appearance resembles spinach. In Greenland a very tasty dish, not unlike stewed rhubarb, is prepared from the sweetened juice thickened with a small amount of rice- or potato-flour.

The Eskimo of Greenland and Alaska eat the fresh leaves of the mountain sorrel, mixed with seal blubber.

Broad-leaved Willow-herb. *Epilobium latifolium.* Fig. 3a.

Erect, glabrous, simple or branching perennial herb from 6 to 18 inches high, with lanceolate, dark green and somewhat glaucous, sessile, and fleshy leaves. The flowers are purple, very large and showy, in leafy racemes. The long and narrow seed pods contain four rows of seeds bearing long, silky, tufts of white hairs at their summits.

The willow-herb is circumpolar in range and is common and even abundant throughout the Arctic on sandy or gravelly, well watered soils such as are found on gravel bars in rivers and on flood plains.

The flowers—the largest in the Arctic—may be eaten raw as a salad; the fleshy leaves are edible when cooked and in taste resemble spinach. In Greenland the fresh leaves and the flowers are occasionally eaten raw with seal blubber.

Eskimo Rhubarb. *Polygonum alaskanum* (*P. alpinum* v. *lapathifolium*). Fig. 4b.

Freely branching perennial herb from a stout, fleshy rootstock several inches thick, bearing leafy stems from 3 to 6 feet high. The stems are reddish with thickened, sheath-covered joints from which rise the 2- to 8-inch long lanceolate-attenuate leaves. The flowers are small and greenish, in large, plumose axillary panicles.

Eskimo rhubarb is common in eastern Asia, Alaska, the Yukon, and east to the Mackenzie and extends north slightly beyond the limit of trees. It prefers moist, alluvial or open soil such as is found along river banks, and on fresh landslides in the permafrost area it may form pure stands several acres in extent.

The young, finger-thick, bright red, and juicy stems appear soon after the snow melts; in flavour they resemble rhubarb and may be used as stewed "rhubarb" and as a pie-filling. The sweetened juice makes a very refreshing beverage.

Kjellman (under *P. polymorphum* f. *frigida*) reports that the Chukchi cook the sliced rootstock with meat and prepare "sauerkraut" from the green stems and leaves.

Arctic Sourdock. *Rumex arcticus.* Fig. 4c,d.

Glabrous perennial with erect, simple stems from a stout, fleshy rootstock. Leaves mostly basal, the blades dark green and somewhat fleshy, oblong-oval to narrowly lanceolate, 3 to 12 inches long and 1 to 2 inches wide, entire-margined and with long and slender stalks. Flowering stems 1 to 3 feet high, terminating in a simple or short-branched panicle of small, reddish flowers.

The arctic sourdock is common in rich, alpine or arctic meadows, ranging from arctic Europe and Asia over Alaska to the Mackenzie District, but does not reach Hudson Bay.

The mildly acid leaves of young stems may be eaten raw as a salad, or cooked as spinach.

Northern Sweet Coltsfoot. *Petasites frigidus.* Fig. 3b.

Extensively creeping perennial herb with a slender rootstock; the flowering stems which precede the leaves and appear soon after the snow leaves the ground, are stout, fleshy and cobwebby, from 8 to 18 inches high, with scaly and much reduced leaves, and terminate in open, racemose corymbs of creamy white scented flowers. The basal leaves are triangular in outline, 2 to 3 inches long, coarsely dentate, green and glabrous above, white-tomentose beneath, on long, slender petioles. Common in wet tundra ranging from northern Europe through Asia, western Alaska, and western Canada almost to Hudson Bay.

The young leaves and flowering stems of the northern coltsfoot may be eaten raw as salad, cooked as a potherb, or made into a "sauerkraut". According to Kjellman this plant is a favourite of the Chukchi, who, from the mature leaves, prepare a special variety of "sauerkraut".

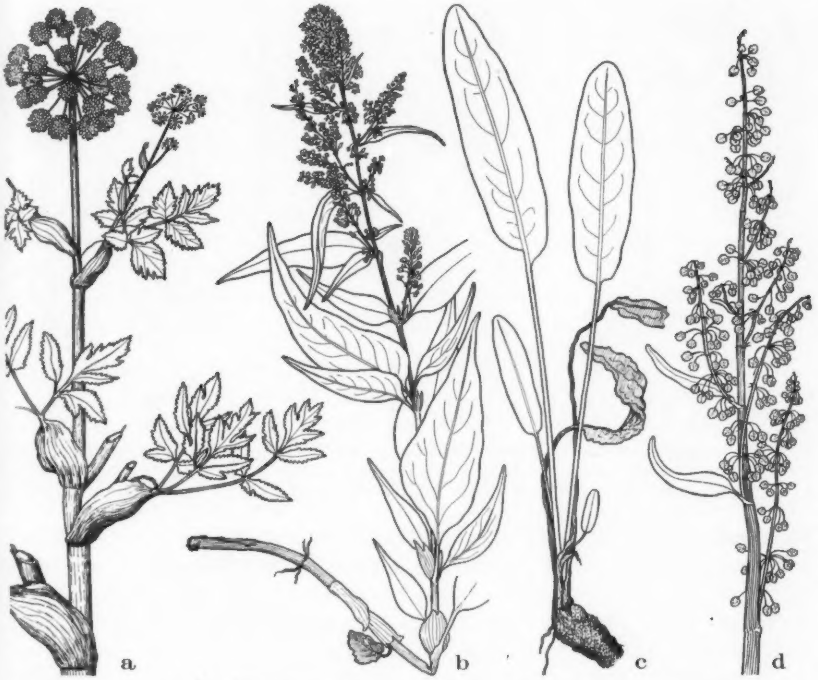

Fig. 4. Potherbs. a, Angelica or *kvan* (*Angelica Archangelica*); b, Eskimo rhubarb (*Polygonum alaskanum*); c, d, Arctic sourdock (*Rumex arcticus*). X 1/3.

Marsh-fleabane. *Senecio congestus.* Fig. 2f.

Biennial with hollow and easily compressed stout, simple stems from 1 to 4 feet high, terminating in a dense corymb of pale, yellow-flowered, woolly heads; leaves ascending, linear to oblong-lanceolate, undulate, dentate, or more or less pinnatifid.

Circumpolar and common in swampy places on the arctic tundra or by the edge of lagoons, but attains its best development on open soil such as landslides in the permafrost area, and on manured soil near human habitations.

The young leaves and flowering stems may be eaten cooked as a potherb, as a salad, or made into "sauerkraut".

Marsh Marigold or "Cowslip". *Caltha palustris s. lat.* Fig. 5c.

A marsh plant of the buttercup family with yellow flowers and glabrous, rather large, roundish or kidney-shaped, dark green and somewhat fleshy tender leaves which may be eaten raw as a salad, or cooked.

There are several races of the circumpolar "cowslip"; one dwarf and creeping race inhabits the high arctic tundra whereas a taller and more robust plant extends far south into the forested region.

Fig. 5. Potherbs. a, Sea purslane or seabeach sandwort (*Arenaria peploides*); b, Dandelion (*Taraxacum arcticum*); c, Marsh marigold or "cowslip" (*Caltha palustris*); d, Willow (*Salix pulchra*); e, f, Scurvy grass (*Cochlearia officinalis* ssp. *arctica*). X 2/5.

Roseroot. *Rhodiola rosea* and *R. integrifolia.* Fig. 3c.

Tufted, succulent perennials, with large, thick and fleshy rootstocks with a fragrance reminiscent of roses. The stems are 6 to 12 inches high and bear numerous, fleshy greenish or pink, oblong, toothed leaves. The flowers are pale yellow or pink, in a terminal cluster.

Two closely related species of roseroot are found in the Arctic. The first is common in northern Europe, south Greenland, and eastern North America; the second is found in eastern Asia and western North America. Both grow in moist places on cliffs and by brooks, often near the sea; in manured soil below bird cliffs or near human habitations they attain lush and profuse growth. The succulent young stems and leaves may be eaten raw as a salad, or cooked as a potherb.

Angelica or *Kvan*. *Angelica Archangelica.* Fig. 4a.

A coarse and glabrous plant, with very large compound leaves on long, hollow, green stalks; the leafy flowering stalks, from 3 to 6 feet high, bear numerous round-topped umbels of small, greenish-white, sweet scented flowers.

An Old World species of alpine–boreal rather than arctic range which extends from Scandinavia west to Greenland, where it is found as far north as Disko Ø (Disko Island). In North America the closely related Purple Angelica (*Angelica atropurpurea*) and Seacoast Angelica (*Coelopleurum lucidum*) are found.

The tender young leaf-stalks and the peeled young flowering stems are eaten raw by Lapps and Greenlanders who consider the *kvan* their choicest vegetable delicacy. To the European palate the raw *kvan* is rather strongly flavoured, but when cooked and creamed it is considered delicious. *Angelica atropurpurea* and *Coelopleurum lucidum* are still more strongly flavoured than the *kvan* and can be eaten only when cooked.

Sea Purslane or Seabeach Sandwort. *Arenaria peploides.* Fig. 5a.

A circumpolar, somewhat fleshy perennial of the chickweed family, common on sandy sea beaches and dunes where it often forms dense carpets or large hummocks.

The succulent young stems and leaves may be pickled as "sauerkraut" or eaten as a potherb.

Dandelion. *Taraxacum.* Fig. 5b.

Several species of dandelions are found in the Arctic where, especially on moist ledges below bird cliffs, or near human habitations, they respond to manure by lush growth. The tender, young leaves of all species, especially when blanched, make an excellent salad, and throughout the summer the leaves may be used as a potherb.

Round-leaved Saxifrage. *Saxifraga punctata.* Fig. 2g.

Low, stemless mostly glabrous perennial from a creeping rootstock. The leaves are erect dark green or reddish with a roundish or kidney-shaped blade on slender stalks; flowering stems 6 to 10 inches high terminating in a short raceme of white or yellowish flowers.

The leaves of this and similar species that are native to eastern Asia and northwestern America are eaten raw with seal blubber or as "sauerkraut" by the Chukchi and the western Eskimo.

Willow. *Salix* spp. Fig. 5d.

According to Kjellman (1882) the leaves of the eastern Siberian willow *Salix kolymensis* (*S. boganidensis*) which was very common around Pitlekaj, furnished perhaps the largest amount of vegetable food consumed by the Chukchi, who, from the young leaves and tender young shoots, prepared a much relished "sauerkraut". Bogoras (1904) adds that the inner bark of willow roots at one time was an important source of food to the Chukchi. The leaves of several arctic willows, including those of the closely related tundra willow, *S. pulchra*, of Alaska and northwestern Mackenzie are equally palatable. Weyer (1932) states that the Eskimo of Alaska eat the young leaves of willow. According to Rodahl (1944) the buds and leaves of arctic willow are exceptionally rich in vitamin C.

Scurvy Grass. *Cochlearia officinalis.* Fig. 5e,f.

Biennial, sea-shore plant with succulent, wintergreen, kidney-shaped, bright green and glabrous, slender petioled leaves. The flowers are inconspicuous, white, in few-flowered racemes; the seed pods are globular, containing a few large seeds.

The scurvy grass is circumpolar and is common along arctic beaches and sea cliffs but is rarely found inland. On well manured moist soil under bird cliffs and near human dwellings it becomes tall and lush.

The somewhat peppery flavoured leaves when eaten raw as a salad, or when cooked, are considered a valuable antiscorbutic and as such are mentioned in the narratives of numerous arctic expeditions; the scurvy grass is not eaten by either Eskimo or Chukchi.

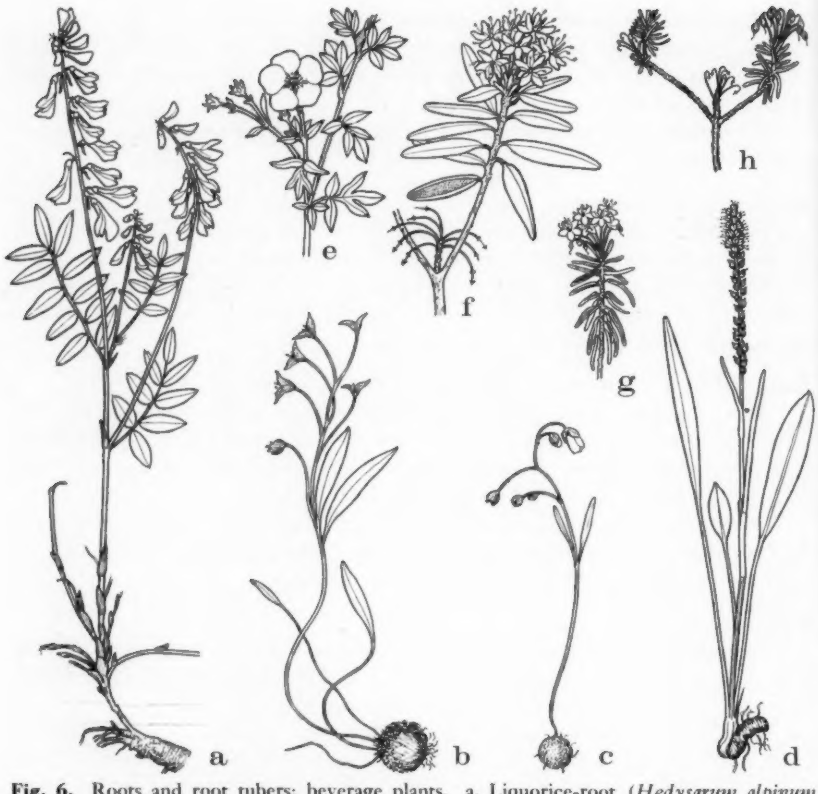

Fig. 6. Roots and root tubers; beverage plants. a, Liquorice-root (*Hedysarum alpinum s. lat.*); b, c, Eskimo potato (*Claytonia tuberosa*); d, Alpine bistort (*Polygonum viviparum*); e, Shrubby cinquefoil (*Potentilla fruticosa*); f, g, h, Labrador tea (f, *Ledum groenlandicum*; g, h, *L. decumbens*). X 2/5.

Roots and root tubers

Root tubers, of several arctic plants, because of their high content of starch and sugar, rank high in food value but owing to their small size, can rarely be obtained in large quantity.

Liquorice-root or *Masu*. *Hedysarum alpinum s. lat.* Fig. 6a.

A non-climbing perennial of the pea family with branching, erect 1- to 2-foot high, leafy stems, with axillary, long-peduncled racemes of showy but rather small, deflexed pinkish-purple flowers. The seed pods are linear, flat. 1 to 2 inches long, formed of several roundish net-veined joints. The leaves are short-petioled, odd-pinnate, with 11 to 21 oblong or oblanceolate leaflets. The half-inch thick root tubers are sweet and taste somewhat like young carrots; they mature in August but may be gathered until the ground freezes. In spring, before the new growth starts, they taste even better than in the autumn, but soon become tough and woody. The root tubers during spring

and early summer form the principal food of brown and black bears; and several kinds of meadow mice in autumn harvest and store the tubers for winter use. In order to obtain a supply of this much favoured vegetable, the Eskimo of Alaska rob the mice "caches" which they locate by means of a dog specially trained for this purpose. Bogoras (1904) reports that this method is also practiced by the Chukchi.

The species, which includes several geographical races, is circumpolar, and from the arctic tundra ranges south far beyond the tree-line; it is common in loamy soil along the banks of rivers and lakes where it often forms large clumps.

Eskimo Potato. *Claytonia tuberosa.* Fig. 6b,c.

The roundish tubers of this Asiatic spring-beauty, found in eastern Siberia and northern Alaska, when boiled are very palatable and nutritious. Kjellman states that along the north coast of the Poluostrov Chukotski this is one of the best known and most used vegetable foods and that even in late spring as much as a barrelful of the tubers might be found in the storehouses of the more provident Chukchi. In 1926 the Eskimo potato was popular also with the Eskimo of Little Diomede Island and northwestern Alaska (Porsild, 1938).

Alpine Bistort. *Polygonum viviparum* and *P. Bistorta* ssp. *plumosum.* Fig. 6d.

Low perennials with a short and thick, tuber-like rootstock and willow-like, green shiny leaves. The small white or pink flowers appear in a rather showy terminal spike. *P. viviparum,* below the flowers, bears numerous small bulbs that take root when detached. The rootstocks, although slightly astringent, are rich in starch and have a sweet, nutty flavour.

Beverage plants

Shrubby Cinquefoil. *Potentilla fruticosa.* Fig. 6e.

A 1- to 3-foot high, much branched shrub with shreddy bark, large yellow flowers, and numerous rather small compound leaves, each formed of from 5 to 7 silky, pubescent leaflets. The shrubby cinquefoil is common throughout the Subarctic, in muskegs as well as in rocky places but is not found far beyond the limit of trees. The dried leaves may be used as a substitute for tea.

Labrador Tea. *Ledum decumbens* and *L. groenlandicum.* Fig. 6f,g,h.

Low, branched, strongly aromatic shrubs with evergreen, leathery, canoe-shaped leaves covered beneath by a dense, rust-coloured felt; the flowers are white, strongly aromatic and spicy, in umbrella-shaped clusters. One or another of the several closely related species occurs throughout the Arctic in muskegs or wet tundra. The leaves may be gathered throughout the year and, after drying, may be used as a substitute for tea.

Spruce Tea.

An infusion made by steeping young twigs and leaves of spruce, hemlock, balsam fir, pine, or birch in boiling water, has long been known to be of value as an antiscorbutic. "Spruce tea", especially if made from the young leaves of balsam fir, is a rather agreeable drink when served hot with sugar.

Fig. 7. Poisonous plants (see p. 17). a, b, c, Red baneberry (*Actaea rubra*); d, Water hemlock (*Cicuta mackenzieana*). X 2/5.

Lichens

"About the last sources of food we should ordinarily think of are the dry, juiceless, gray, drab or brown lichens, often mistakenly called 'mosses,' which carpet sterile ground or expand their flat or crisped surfaces on rocks,

fences or trees" (Fernald and Kinsey, 1943, p. 406). Nevertheless, among the various edible plants occurring in the North, the greatest potential food value should, perhaps, be assigned to these uninspiring plants, because they occur so abundantly that 4 to 5 tons may sometimes be harvested from one acre.

Lichens are low, variously shaped gray, yellow, brown, or black plants that, in many parts of the Arctic (and elsewhere), are important components of the vegetation. Botanically they are curious dual organisms composed of a fungus that receives its nourishment from primitive green or blue-green algae that are completely enveloped by, or diffused through, the hyphae of the fungus.

Many different kinds of lichens are found in the Arctic and while none is poisonous, only a few are palatable to man. Most lichens contain an acid substance that may cause nausea or severe internal irritation, unless removed or neutralized by parboiling in water to which has been added a small amount of baking soda.

Among the most easily recognized edible lichens are certain rock lichens of the genera *Gyrophora* and *Umbilicaria*—commonly known as "rock tripe" or "tripe-de-roche"—and a few species of *Cladonia* and *Cetraria*, often mistakenly referred to as "moss" or "reindeer moss".

The former, as the name implies, grow on rock or boulders to which their irregularly shaped, saucer-like, leathery, brown, green, or black fronds are attached by the centre. When dry they are hard and brittle, but in damp weather become soft and cartilaginous and in this condition are easily detached from the rocks. The "mossy" kind grow on the ground, often among other plants, and sometimes form dense and almost pure carpets. The most important of these are the Iceland moss (*Cetraria islandica*), said to contain 80 per cent "lichen-starch", besides some protein and fat, and "reindeer moss" (*Cladonia rangiferina*, *Cl. sylvatica*, and *Cl. alpestris*). These are low, bushy, coral-like lichens. The first is dark brown, its fronds strap-like, crisply ciliated on the edges while the fronds of "reindeer moss" are more coral-like, composed of round, hollow gray or greenish-gray, branches. These lichens, too, are brittle when dry and are best collected when moist.

After parboiling with soda, the lichen should be dried, preferably in an oven, until brittle and then powdered; this may be done by rubbing between the palms of the hands, or by pounding, or better yet by a grist mill.

The powdered lichen, if put to macerate in water overnight, will jell when boiled with water or milk. One pound of powdered Iceland moss will produce four quarts of jelly similar to blancmange and is considered very nutritious and digestible. In Iceland and in northern Scandinavia, Iceland moss is used in puddings and in soups; and formerly, in times of scarcity, flour prepared from this and other lichens was added to the bread-flour. The moistened lichen-flour will not form a dough unless mixed with a small quantity of wheat-flour. Very tasty biscuits may be prepared from equal parts of lichen- and wheat-flour.

The starch-like substance contained in the lichen may be fermented, and in Scandinavia formerly found a limited use in the manufacture of alcohol.

Mushrooms

Many different kinds of edible mushrooms and puffballs occur throughout the Arctic, especially near the southern fringe of the tundra where, in midsummer and early autumn, bushels of these fungi may be collected. Thus far no poisonous species have been detected north of the tree-line although the deadly toadstool (*Amanita phalloides*) has been found in the wooded parts of the upper Mackenzie basin and in the Yukon.

Seaweed

A number of edible species of seaweed or marine algae occur along rocky shores of the arctic seas and several are used regularly, if mostly in times of scarcity, by the Eskimo. In Greenland, several species, including *Rhodymenia palmata* and *Laminaria* spp. are eaten raw, dipped in boiling water or with seal oil. Rodahl (1950) estimated that 50 per cent of the vitamin C intake of the east Greenland Eskimo is derived from marine algae.

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THE NAMING OF BIRDS BY NUNAMIUT ESKIMO

Laurence Irving*

It is rare for people of two different cultures to have as good an opportunity of comparing their knowledge as Simon Paneak and I had when I was learning the Nunamiut Eskimo names for birds in the Anaktuvuk Pass region, interior arctic Alaska. The scientific list of birds of that region which I prepared provided me with a check on the completeness and accuracy of the Eskimo method of naming part of the local environment. Our relations were sufficiently close and prolonged so that we could both ascertain that we were designating the same birds by our Eskimo and English names.

The English names of birds used in this study have been modified by convention of scientists to express taxonomic designations, and they are in no sense popular names. The Nunamiut names are those used by a small group of people to indicate birds in their environment. Having no knowledge of natural history in times or places outside their own small community's experience, we should not seek in the Nunamiut names for the implications of scientific taxonomy. The Eskimo preserves his names without writing or museum to serve his memory. We who depend upon written records marvel at the persistence of stable knowledge which can be fixed in oral records, but we should recall that a large degree of stability is inherent in speech.

Anaktuvuk Pass leads approximately north and south through the centre of the Brooks Range. About one hundred miles north of the arctic circle the southern border of these mountains extends from the Yukon Territory to the western arctic coast of Alaska. The mountainous band is about one hundred miles wide, with reported elevations around 10,000 feet in the east which gradually diminish toward the western coast. The northern limit of trees lies to the south of the watershed of the mountains. In the forested valleys summer rains are frequent, and deep snow remains uncompacted by wind, but in the treeless arctic mountains and on the tundra rainfall is light. The sparse snow is driven by fierce winds which bare large areas and compact the snow firmly where it lodges. In addition to the barrier of elevation, the climatic transitions of the mountain region are significant to life.

Anaktuvuk Pass preserves some of the trough-like form given by the glaciers which shaped it. Near Summit it is a valley some four or five miles wide with lowest elevations about 2,200 feet. The deeply intersected mountain walls rise steeply to nearby peaks 6,000 feet in elevation. Through this valley many migrant birds pass northward in May and early June to settle in the mountain valleys and spread over the Arctic Slope to the coast. The birds are concentrated mainly at the lowest elevations, which in this treeless area favours their observation.

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A community of about sixty-five Eskimo calling themselves Nunamiut now live at Summit, where for about two years their tents have usually been centred about a post office located in Homer Mekiana's tent. This recent innovation restricts their former free movement among the mountains where they used to travel as the presence of caribou, some fishing, and availability of willow fuel dictated. They trace their origin through three generations of residence, nearly one hundred years, among the mountains. Stories of older ancestors must be called prehistoric but the Nunamiut consider themselves derived from an ancient inland people distinguished in dialect, style of clothing, and methods of hunting from Eskimo of the coast. Physical measurements show this small group to be different from some other Eskimo groups, and their present customs which vary from those on the coast add evidence for the origin which they claim in the once numerous and probably distinct inland Eskimo people (W. Irving, unpublished).

Stoney and Howard (1900) visited this area in 1885 and 1886 and spent two winters travelling among the many temporary Eskimo villages of hunters then moving about in the mountains. But in 1920 the last of the mountain Eskimo moved to the coast. As whaling and the price of furs declined this particular group of Nunamiut Eskimo left the coast and returned to resume their old life as caribou hunters in the mountains. The remainder are now nearly merged in other communities.

After Schrader's (1904) geological reconnaissance party traversed Anaktuvuk in 1901, a few prospectors and traders went through the mountains in prodigious feats of travel which have left no written record. Early air travel to the arctic coast used Anaktuvuk Pass for a route northward, and venturesome pilots explored the mountains. In particular, Sigurd Wien used to drop in to visit the Eskimo in the mountains, where he learned to rely upon the accuracy of their geographical information. It was with Mr. Wien that I first visited the Nunamiut in 1947.

Since that time many biologists, anthropologists, teachers, traders, and sportsmen have visited Anaktuvuk for varying periods. Ingstad (1951) has written about his stay with them through the winter of 1949–50. Rausch (1951) has described the mammals of the region and the Nunamiut devices and procedures employed in their capture and utilization. William Irving (1951) has identified the finely worked small flint artifacts of an old campsite in Anaktuvuk with those found by Giddings (1951) at Cape Denbigh, Alaska, where relics of one of the oldest known American cultures were discovered.

As a result of this intercourse with strange people and new ways, the Nunamiut have been much affected. While many old ways have been superseded in the confusion of recent innovations, the older people still tenaciously preserve much of the knowledge of ancient times. But it must be sought with patience and understanding, for confusion of their thought and expression has been caused by rapid changes in their way of life.

During my first visit with the Nunamiut at Chandler Lake in November 1947, I obtained a remarkably good idea of the avifauna of the mountains simply from long conversations in their warm skin tents. Since then I have

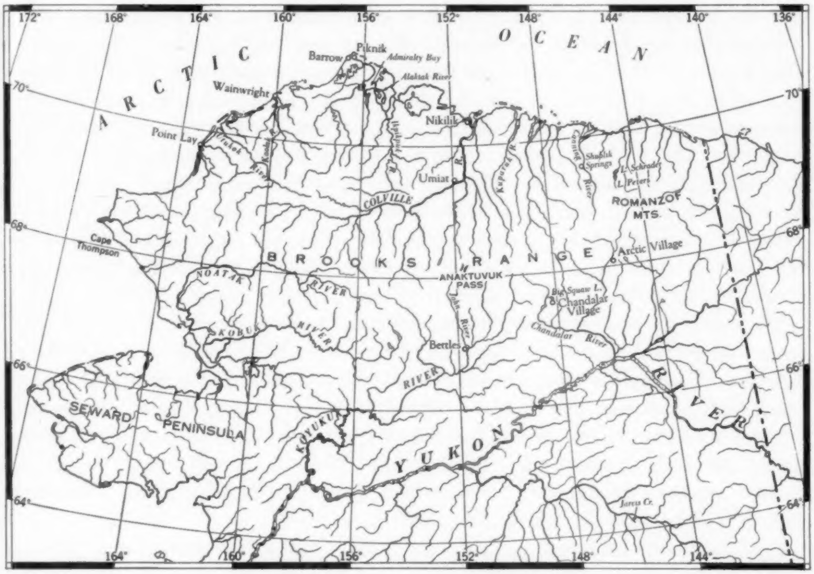

Fig. 1. Northern Alaska.

recorded many observations of birds obtained from adults and children of the village whose accuracy I could verify in our close and pleasant association. About 1,000 specimens have been transferred to the U.S. National Museum, where, with the aid of Dr. Herbert Friedmann, I have settled on the identifications of the avifauna listed in Table 1, pp. 41–3. The account of the ornithological studies will be published elsewhere.

Simon Paneak of Anaktuvuk has been my constant companion in field studies, and he has kept accurate records for me of his observations during the five years of our association. He expresses himself clearly in English marked by accurate use of a large vocabulary. In contrast with my failure to learn Eskimo, his range of expression in English has increased rapidly. As he acquired the English names of birds he has written for me the Eskimo names. From many repeated comparisons with other Nunamiut, I believe that the names which he gave are from the usage of older Nunamiut people. I have given Paneak's spelling even though it does not follow any previously used system of Eskimo transliteration, because it was consistent and proved adequate to indicate the birds both to him and to a few other Nunamiut. The most complete list of Eskimo bird names for this part of Alaska so far published (Anderson, *in* Stefansson, 1913) lists most of the birds given in Table 1, but only about half as many Eskimo names.

I was also greatly helped by my friend Thomas P. Brower, who, following his eminent father at Barrow, had studied and collected the birds of the arctic coast. In the early summer of 1949 he made a collection for me at Anaktuvuk

including most of the species of birds with numerous nests. Aided by this collection, I knew about 90 forms of the avifauna at that time which now in 1952 I list at 103. The Nunamiut names of birds of Anaktuvuk with the names in English are given in Table 1; from this it can be seen that Paneak was able to name 89 of the birds. I have also included 10 birds (indicated by brackets) in this list which I had found within some fifty miles of the northern edge of the forest, but which we have never found on the treeless tundra; 7 were named by Paneak, and of the 3 for which we could not find a name, only the Bohemian Greater Waxwing was previously unknown to the Nunamiut. The name of the Ross's Gull is included in square brackets, as the single specimen observed was undoubtedly a wanderer from the arctic coast.

Some birds occasionally visit Anaktuvuk from adjacent ranges. Although these visitors are not settled in the treeless mountains their visits appear to represent a normal inclination of certain birds to explore areas within a few hours flight of their usual range. Only an Eastern White-crowned Sparrow was recorded as of accidental occurrence. It was so remote from its usual range that it could have succeeded in returning to its own kind only by a second series of accidents. On the whole the Anaktuvuk birds were very regular in time and place of appearance.

Among the birds of Anaktuvuk a few taxonomic distinctions present ornithological problems. Only close observation can distinguish between Hoary and Mealy Redpolls and between Greater and Lesser Scaup Ducks. The Nunamiut had originally one name for the two redpolls and one for the two scaups. Some of them can now distinguish the redpolls and all recognize that there are two forms of scaups. So far as I can learn they have not considered new names for these birds, using either English names or a descriptive expression which is not a true name.

I do not have specimens for determining whether there is more than one form of White-fronted Goose at Anaktuvuk. The Eskimo think of it as "the Goose", and I doubt whether from local experience only that it would be possible to realize that two forms of this goose exist.

I am sure that the following birds occur at Anaktuvuk, but explicit taxonomic treatment is as yet unclear to me: Rough-legged Hawk, Bar-tailed Godwit, and Flicker.

The Nunamiut have three names for gyrfalcons depending on the age of the birds. This special attention arose from the spectacular habits of the gyrfalcon and because of the value of their feathers. These feathers were used by the Eskimo as guides for arrows and spears and furnished the mountain people with an important commodity for trade at the coast where gyrfalcons are rare.

I could not discover Nunamiut names for the following birds which I have rarely found at Anaktuvuk: Shoveller, American Sparrow Hawk, Upland Plover, Stilt Sandpiper, Flicker, and Northern Pileolated Warbler. Simon Paneak had seen a few Shovellers on the arctic coast and the skin of a Flicker had been shown to him by his friend David Tobuk at Bettles. The other four birds were unknown to him and to the other Nunamiut.

I could learn no Nunamiut names for the following birds which are distinctive in appearance and not rare: Northern Bald Eagle, American Herring Gull, Northern Say's Phoebe, and separate names for the Barn, Bank, and Tree Swallows.

The Nunamiut knew the Bald Eagle from their occasional travel in the forested regions and from its occasional visits northwards, but could not recall any name. Their lack of familiarity with the rather conspicuous Herring Gull is probably explained by the fact that Eskimo discard little food, hence the large gulls do not approach dwellings and are usually so shy as to make identification difficult. The Nunamiut had however occasionally reported seeing large gulls with black wing tips, but could give no name for them. The Nunamiut first recognized the Northern Say's Phoebe with me in 1950. Thereafter we found them occasionally, and they were surprised that such a distinctive bird had remained unknown to them. The three local swallows were known by one name. The more distinctive but uncommon Barn Swallow was well known, but the Bank and Tree Swallows which, although frequent visitors, are only observed in swift flight, were not distinguished until I demonstrated the difference between them.

Paneak's descriptions of old scenes have been so vivid that while listening to them I could share completely in appreciating the circumstances. These interesting narratives of his former experiences were many times repeated. When I compared his long-remembered information about places with a map or locality which I had recently seen or when I referred his accounts to events and dates recorded by scientists and explorers I found Paneak's memory precise. Although his memory and its expression are uncommonly clear even for an Eskimo, I have found that a faithful memory is a commonly cultivated faculty among them. As Simon Paneak remarked, an Eskimo keeps his map in his mind.

An instance of remarkable Eskimo memory illustrates the use of this faculty in preserving observations of nature. Paneak and I had frequently discussed the Horned Grebe and we had tentatively associated it with a bird named *Malikak*, which he said that his father had shot with his .44 calibre rifle on the Colville River when he was a boy, about 1907. According to his father's custom they had examined the bird carefully and after discussing its unusualness his father had told him the name. In 1951 I shot two of these grebes. When I showed them to Paneak he at once applied the name *Malikak* and identified them with the birds which his father had shot forty-four years earlier, but which he had not otherwise seen. Of three other men then present, one had seen *Malikak* many years ago on the Colville and two said they had not seen it before. The negative statements were as definite as the positive ones.

Many times Paneak and I have discussed the birds characteristic of the eastern arctic coast of Alaska which he has not seen for sixteen years. During my residence at Point Barrow I had made myself familiar with the birds of that region, and Paneak could identify all that I could describe well enough or could illustrate. He recalled the rare capture of what were probably guillemots,

but he was certain that he had not seen auks, puffins, or cormorants. In conversation with other Nunamiut men I found no understanding of these sea birds which are so distinctive and characteristic of the Bering Sea and western arctic coasts of Alaska. To a large extent the older Nunamiut depend on information impressed on their memory by their parents and grandparents, but this knowledge is frequently reviewed in discussions. Therefore I consider that their clear knowledge of the birds of the eastern coast and their lack of knowledge of those of the western coast is significant of the experience of this Nunamiut group and of the two older generations.

A few of the Anaktuvuk people have been in Kotzebue, but they seem to have little interest in the western arctic coast. In contrast, I have listened fascinated for many hours to vivid narrative accounts by older men describing events in their earlier travels down the Colville River and eastward along the coast. Several men have been east of the Mackenzie and some sixty-five years ago Jesse Ahgook travelled among the people of the Coppermine River.

The ability to designate accurately most of the birds of their environment may be special to this particular group of Nunamiut people. I would rate their quickness of understanding and skill in social relations high even in comparison with small groups of white people who were selected for scholarly ability. These few Nunamiut families elected to withdraw from the fringes of rudely expanding white civilization to return to the enjoyment of their own way of life in the mountains, and this return required more vigour and self-reliance than to remain in the current of advancing mechanization. So these people are a selected group chosen by their special inclinations.

The Nunamiut knowledge of birds is not comparable with ornithology since they lack knowledge of natural history in other regions of the world. It is primitive in the sense that its core lay in the Nunamiut people prior to their contact with scientific methods of thinking. It seems to me though that their reliance on the memory of friends and relatives fosters attention for orderly accurate observation and vivid recollection. In our resort to written records we often put the real observations out of our minds and our names represent specimens or writing rather than birds. Whatever the processes underlying the Nunamiut naming of birds it is interesting to see how well it distinguishes those birds found in their own environment.

In addition to my acknowledgment in the text for the friendly interest of the Nunamiut people, I wish to express thanks to William Irving for his helpful companionship in the field and for critical assistance in obtaining the Nunamiut names and their meanings through his knowledge of the Eskimo language. Dr. Herbert Friedmann has made it possible for me to compare the specimens of Anaktuvuk birds with those in the collections of the United States National Museum and has reviewed the ornithological names used. Dr. Henry B. Collins, Jr. has given me much helpful criticism in the preparation of the manuscript.

Table I. Nunamiut Eskimo names for the birds of Anaktuvuk Pass. Status of birds in the avifauna: N—nesting, M—migrant, V—visitor, A—accidental, WR—winter resident, F—forest. Names of birds of adjacent regions in brackets.

English Name	*Status*	*Nunamiut Name*	*Meaning*
Common Loon	NM	Tasingik	Black-billed
Yellow-billed Loon	VM	Tootlik	
Pacific Arctic Loon	NM	Malirgik	
Red-throated Loon	NM	Kaksrauk	(call)
Horned Grebe	V	Malikak	Little loon
Whistling Swan	M	Kogruk	White
Taverner's Goose	M	Eksrahgotolik	Light-coloured cheek
Black Brant	M	Niklinagak	Almost like (White-fronted) Goose
White-fronted Goose†	M	Niklivik	Goose
Lesser Snow Goose	M	Kangok	
Common Mallard	NM	Ogiuguk	(call)
American Widgeon	NM	Koruaknak	Like pintail
American Pintail	NM	Korugak	
Green-winged Teal	NM	Korualorgosik	Smaller than pintail
Shoveller	V		
Greater Scaup Duck	NM	Kaklutuk	Big-billed
Lesser Scaup Duck	N		
Old-squaw	NM	Ahalik	
Western Harlequin Duck	NM	Ahaliknak	Like Old-squaw
White-winged Scoter†	NM	Tongargakruk	Devil
Surf Scoter	NM	Avilyuktok	
Red-breasted Merganser	NM	Akpaksruayook	Runs (like a man) on top of water
(Eastern Goshawk)	F	Kidgavitch Kiringit	
Rough-legged Hawk†	NM	Kilyirgik	Basket sled
American Golden Eagle	NM	Tikmiakpuk	Largest bird
Northern Bald Eagle	V		
American Marsh Hawk	V	Papiktook	Long (parky) tail
American Osprey	V	Kalloksioyuk	Goes after fish
American Gyrfalcon	NWR	Okiotak	The one that stays all winter
" "		Kitgavikroak	
" " young		Atkuaruak	Like caribou mittens
American Peregrine	NM	Kidgavitch Kiriat	Small hawk
Western Pigeon Hawk	NM	Kidgavitchaurak	Smallest hawk
American Sparrow Hawk	V		
(Hudsonian Spruce Grouse)	F	Napaktom Kadgia	Grouse of the trees
Alaska Willow Ptarmigan	NMWR	Kadgivik	Having comb on head
Nelson's Rock Ptarmigan	NWR	Niksaktongik	The "belcher"
(Sharp-tailed Grouse)†	F	Odgillyim Kadgia	Birch grouse
Lesser Sandhill Crane	M	Tattidgak	
Semipalmated Ringed Plover	NM	Kodrakoruk	(call)

* English names used follow those of the 'American Ornithologists' Union's Check List' of North American Birds.

† Subspecies not determined.

( )Birds found in forested areas only.

English Name	*Status*	*Nunamiut Name*	*Meaning*
Northern Killdeer	V	Talikvak	
Eastern American Golden Plover	NM	Todlik	(call)
Black-bellied Plover	M	Todlivak	
European Turnstone	M	Talivikeak	
Wilson's Snipe	NM	Avikiak	(Sounds) like the walrus
Hudsonian Lesser Curlew	M	Sigoktovak	Long-billed
Upland Plover	V		
Spotted Sandpiper	V	Oklaktak	
Western Solitary Sandpiper	M	Kipilugoksioyuk	Looks for insects
Wandering Tatler	NM	Silyirisoktok	Like sharpening with a stone
Lesser Yellow-legs	NM	Ovingoayook	The "whistler"
Pectoral Sandpiper	NM	Poviaktook	Inflating the chest
Baird's Sandpiper	NM	Nuvuksruk	Sounds like a man with a bad cold
Least Sandpiper	NM	Livalivaurak	Small *Liva Liva*
Red-backed Dunlin	M	Kayutavak	Big dipper
Long-billed Dowitcher	M	Kilyaktalik	Like a bundle when seen from behind
Stilt Sandpiper	M		
Semipalmated Sandpiper	NM	Liva Liva	(call)
Buff-breasted Sandpiper	M	Aklaktak	Spotted
Bar-tailed Godwit†	M	Toratoruk	
Sanderling	M	Kimitkoilyak	Having no heel
Red Phalarope	M	Auksruak	Coloured like blood
Northern Phalarope	NM	Kaiyiorgon	Float like a kayak
Pomarine Jaeger	V	Isongngakluk	Poorly winged
Parasitic Jaeger	NM	Mirgiaksyook	Vomit
Long-tailed Jaeger	NM	Isongnatcheak	Young or new jaeger
Western Glaucous Gull	NM	Nauygavak	Large gull
American Herring Gull	V		
Short-billed Common Gull	NM	Nauyatcheak	Beautiful gull
[Ross's Gull]		Kakmakloak	
Sabine's Gull	V	Kadgagiak	
Arctic Tern	NM	Mitkotailyak	Drooping feathers
Northwestern Horned Owl	V	Nukisirgak	Powerful
Snowy Owl	MWR	Okpik	
(American Hawk Owl)	F	Neakoktoakruk	Medium sized head
(American Great Gray Owl)	F	Nattak	
Northern Short-eared Owl	NM	Nipailyutak	The "screecher"
American Tengmalm's Owl	V	Takpilyakruk	Pretty good-sighted
Flicker†	V		
Nelson's Downy Woodpecker	V	Toyuk	The "borer"
(Alaska Three-toed Woodpecker)	F	Toyukpuk	Big *Toyuk*
Northern Say's Phoebe	NM		
Pallid Horned Lark	NM	Nakrulik	Horned
Tree Swallow	V	Tulugaknek	Like a raven
Common Bank Swallow	V	Tulugaknek	Like a raven
Barn Swallow	V	Tulugaknek	Like a raven
Alaska Gray Jay	NVWR	Kirik	(call)
Northern Raven	NWR	Tulugak	(call)
Yukon Black-capped Chickadee	VWR	Misikakak	The "jumper"
(Hudsonian Boreal Chickadee)	F		
Northern Dipper	NWR	Anaruk Kiviruk	Old woman sunk

English Name	*Status*	*Nunamiut Name*	*Meaning*
Eastern Robin	NM	Koyapigaktoruk	(song)
Northern Gray-cheeked Thrush	NM	Niviolruksioyuk	Goes after flies
European Wheatear	NM	Tikmiakpauruk	Little eagle
Kennicott's Arctic Willow Warbler	NM	Songakpalutunygik	Small bird the colour of bile
(Eastern Ruby-crowned Kinglet)	F		
Alaska Yellow Wagtail	NM	Piorgak	(call)
American Water Pipit	NM	Piorgavik	(call)
(Bohemian Greater Waxwing)	F		
Alaska Great Shrike	NM	Irirgik	Eye extractor
Northern Pileolated Warbler	N		
Rusty Blackbird	NV	Talungiksyaurak	Little raven
Alaska Pine Grosbeak	NVWR	Kayatavak	
Gray-crowned Rosy Finch	NM	Kaviksruak	Refers to red colour
Coues's Hoary Redpoll	NMWR	Suksangik	
Mealy Redpoll	NM		
(American White-winged Crossbill)	F	Pakagik	
Western Savannah Sparrow	NM	Okpisioyuk	Staying mostly in willows
Northern Slate-colored Junco	V	Kayatavaurak	Small grosbeak
Western Tree Sparrow	NM	Misapsak	
Eastern White-crowned Sparrow	A		
Gambel's White-crowned Sparrow	NM	Nungaktuakruk	
Yukon Fox Sparrow	NM	Iklikvik	Tool container
Alaska Lapland Longspur	NM	Potokioluk	
Smith's Longspur	NM	Kallorgosiksook	Sings with the voice of many birds
Eastern Snow Bunting	M	Amauligak	Like male eider duck, i.e., variegated black and white

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RECENT CHANGES IN THE SHORELINE NEAR POINT BARROW, ALASKA†

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The tundra of the Point Barrow area is part of the coastal plain that forms the northern section of the Arctic Slope of Alaska. Like all typical coastal plains, it is underlain by poorly consolidated materials. It differs from more southerly coastal plains chiefly in the presence of ground ice throughout its extent, and in such geomorphic features as innumerable lakes and swamps, soil polygons, and other phenomena caused by permafrost. Many abandoned beach ridges, spits, and other shore features in an excellent state of preservation are to be found at various distances from the present shoreline, testifying to a relatively recent general emergence. The region discussed in this paper is shown on Fig. 1, which is based on Charts 9445 and 9495 issued by the U.S. Coast and Geodetic Survey.

Several segments of coast may be distinguished in the vicinity of Point Barrow. For some 50 miles southwest from Barrow village the shore of the Arctic Ocean is composed of low cliffs or bluffs 25 to 70 feet high, cut in poorly consolidated sand and clay. These bluffs are nicked by numerous small hanging gullies, and are broken by several small stream valleys, most of which show signs of slight drowning. From Barrow village to the base of the sand spit that leads to Point Barrow the shore is low and gravelly, and is backed by low, grassy tundra. From the base of the sand spit northwards the coast is a low, narrow sand-and-gravel bar except at the point itself, where it widens and carries many sand dunes, some of which are 16 feet or more in altitude. Beyond the tip of Point Barrow the spit continues in a southeasterly direction for 2½ miles to Eluitkak Pass, separating Elson Lagoon from the Arctic Ocean. From Eluitkak Pass to Christie Point, Elson Lagoon is protected from the ocean by the Plover Islands, a series of low barrier beaches broken by many inlets. The south shore of Elson Lagoon, from the base of the Point Barrow sand spit to Christie Point, is somewhat like the shore southwest of Barrow village. It is composed for the most part of low cliffs or bluffs cut in unconsolidated materials and broken by one small and one fair-sized estuary. These cliffs are nowhere more than about 20 feet high and are usually much lower.

Although protected from wave action by sea ice for at least half the year, these various coastal segments are being eroded rapidly and at a few places it has been possible to measure the rate of shoreline retreat.

Leffingwell[1] gives a generalized description of the arctic coastline of Alaska, and discusses in some detail its development, recent changes, and rate

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[1]Leffingwell, E. de K. 1919. 'The Canning River region, northern Alaska'. *U.S. Geol. Survey Prof. Pap.* 109, pp. 169–71.

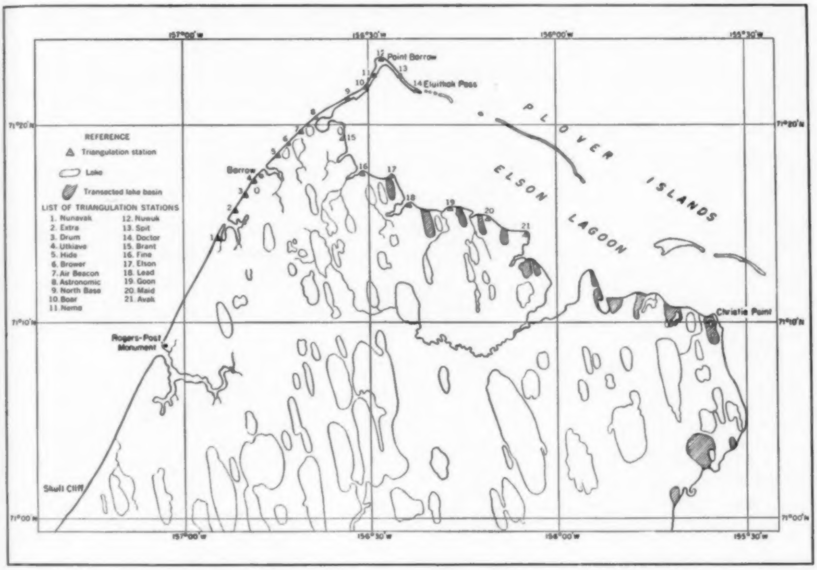

Fig. 1. Sketch-map of Point Barrow area. None of the numerous swamps and only a few of the lakes and streams are shown. Redrawn from charts 9445 and 9495 issued by the U.S. Coast and Geodetic Survey.

of erosion. Although most of his specific descriptions apply to an area well to the east of Point Barrow, his conclusions can probably be extended to the Barrow region. According to his determinations Flaxman Island had been cut back "at least half a mile" between 1826 and 1914. The sharp point of land extending "a mile or so" into Smith Bay in 1837, to which the name Cape Simpson was given at that time, had been cut back so far since 1853 that it was "now impossible to locate the place where the name was applied." A lake near Point Drew, said to be 4 miles from the coast in 1837, was only 2 miles from it in 1914. Leffingwell estimates a rate of 30 feet per year for the retreat of the shoreline at Brownlow Point, east of Flaxman Island, between 1901 and 1907 and a rate of 100 feet per year for Cape Simpson and Point Drew. He further states that: "An average retreat of 10 feet for all the cliffs on the north shore is estimated for the summer of 1911, but as scarcely any retreat occurred between 1911 and 1914, the average retreat must have been less than 4 feet."

Evidence of retreat of the shoreline

Skull Cliff to Barrow village—The fresh appearance of the cliffs along this segment of the coast, cut as they are in very non-resistant material, the recurrent landslides and slumps down the face of the bluffs, and the innumerable small hanging gullies which notch the crest of the bluffs, all attest to a rapid retreat. Although there are several U.S. Coast and Geodetic Survey triangulation

stations along this stretch of coast,[1] measurements were made at only four of them. These measurements indicate that the rate of retreat between 1945 and 1951 was too slight to be determined quantitatively, although fresh slumps in the immediate vicinity of each of the stations visited indicated that some retreat was taking place.

Barrow village to base of sand spit—There are several small ponds or lagoons along this stretch of coast, each of which is separated from the Arctic Ocean by a beach bar. At least two of these lagoons are almost certainly small estuaries, while the others seem to be tundra lake basins which have been cut into by the retreating shore. If actually transected lake basins, these small lagoons offer proof of a recent, although by no means necessarily a present-day, retreat of the shore.

In October 1949 measurements were made at three triangulation stations along this segment of coast, and indicated that during the period 1945–9 the shore had been built out an average distance of about 27 feet. Measurements made in the summer of 1951 seemed to show that this advance had been replaced by a retreat which averaged 17 feet during the period 1949–51. This particular bit of beach has been greatly disturbed by dredging for gravel and by the maintenance of a road along its inner margin, so that these figures cannot be taken as representative of natural changes in configuration.

Base of the sand spit to Point Barrow—Measurements made at such of the 1945 triangulation stations as could be recovered indicate an average retreat along this coastal segment of about 16 feet during the period 1945–9. Measurements taken in 1950 and 1951 indicate an average retreat of about 24 feet in the period 1949–51. At 'Nuwuk'[2] the evidence of rapid retreat is especially striking (Fig. 3). The abandoned native village of the same name, which formerly occupied most of the area immediately surrounding the station site, is being rapidly eaten away by the retreat of the bluff and in October 1949 the remains of four old pit dwellings, then partially collapsed and filled with solid ice, were exposed in cross section in the face of the bluff. In 1951 these four dwellings had been completely eroded away, and several more exposed.

Point Barrow to Eluitkak Pass—Only one of the 1945 triangulation stations in this area was recovered, and it was in process of being destroyed by wave action in October 1949 (Fig. 2). The 1945 records are not clear in regard to this station: on one interpretation the shore must have retreated 86 or 87 feet during the period 1945–9, while according to an alternative interpretation the retreat was not much over 60 feet. This station was not revisited in 1950 or 1951.

[1]U.S.C. & G.S., (planographed publication) "Alaska No. 80: description of triangulation stations, vicinity of Point Barrow", no date, and similar publication "Alaska No. 84: descriptions of triangulation stations, Barrow to Wainwright, Alaska." Additional information was obtained by personal communications from Lt. Cmdr. Robert A. Earle, U.S.C. & G.S.

[2]Nuwuk, the Eskimo name for the abandoned village near the tip of Point Barrow and for the point itself, is usually translated as "used to be a point (of land)." Thus it would seem that the native inhabitants of this locality recognized that rapid erosion was taking place.

Fig. 2. Triangulation station 'Doctor', at the extreme end of the sand spit projecting southeast from Point Barrow, being undermined by wave action. 20 October 1949. This station was recorded as being 85 feet from the shoreline in September 1945.

Fig. 3. Bluff at the tip of Point Barrow composed of dune sand cemented by interstitial ice. Pit dwellings are exposed in the seaward face of this bluff. Triangulation station is 'Nuwuk'. 13 September 1949.

Plover Islands—While several triangulation stations were established on these islands in 1945, most of them have since been destroyed by wave or ice action, and it was not considered worth while to visit them.

South shore of Elson Lagoon—Although most of Elson Lagoon is quite shallow, with a rather uniform depth of 8 to 10 feet, and is cut off from the Arctic Ocean by the Plover Islands, its south shore is undergoing rapid erosion. The innumerable small hanging gullies and the many fresh slumps at the foot of the low bluffs give evidence of rapid retreat. There are many transected lake basins, some of which are shown on Chart No. 9495 of the U.S.C. & G.S. (Point Barrow to Smith Bay), and many more not shown on this chart may be seen from the air. Although numerous triangulation stations were established along this shore in 1945, in almost no case is the distance to the water line given in the available records. Some of these stations were visited in 1949, 1950, and 1951, and the measurements made at these times are presented as a part of Table 1.

Table I. Measurements made at triangulation stations.

Station	*Distance to shoreline (feet)* Sept. 1945	Oct. 1949	July–Aug. 1950	July 1951	*Change (feet)*	*Annual change (feet)*	*Measured from**
Nunavak	165 (approx.)	–	170	–	+ 5 ('45–'50)	+ 0.9	bluff
Extra	165 (approx.)	–	150	–	–15 ('45–'50)	– 3.0	bluff
Drum	262 (approx.)	–	–	267	– ('45–'51)	–	bluff
Utkiave	265	265	265	265	– ('45–'51)	0.0	bluff
Hide	180	231	225	226	+46 ('45–'51)	+ 7.9	water
Brower	150	151	150	125	–25 ('45–'51)	– 4.3	water
Air Beacon	400	431	397	411	+11 ('45–'51)	+ 1.9	water
Astronomic	–	237	231	214	–23 ('49–'51)	–13.1	water
North Base	170	135	149	95	–75 ('45–'51)	–12.8	water
Boar	110	124	121	94	–16 ('45–'51)	– 2.7	water
Nemo	–	249	252	238	–11 ('49–'51)	– 6.3	water
Nuwuk	50	22	17	7.5	–42.5('45–'51)	– 7.1	bluff
Doctor	85	25	(destroyed)	–	–60 ('45–'49)	–14.7	water
Brant	600	485	–	481	– 4 ('49–'51)	– 2.3	water
Elson	–	150 (Jan. '50)	–	141.5	– 8.5('50–'51)	– 5.7	bluff
Lead	–	3.5	–	–5 (est.)	– 8.5('49–'51)	– 4.9	bluff
Goon	–	44 (Jan. '50)	–	34	–10 ('50–'51)	– 6.7	bluff

*"Bluff" indicates measurements to top of bluff; "water" indicates measurements to water line at time station was visited.

Physical processes involved in the erosion

Where cliffs are distinct, as between Skull Cliff and Barrow village, undercutting at the foot, followed by slumping and landsliding down the face of the bluff, seems to be the chief erosive process at work. This process is aided and accelerated by the presence of a great deal of ground ice, which, when it melts, not only greatly reduces the coherency of the cliff face, but also

Fig. 4. Island of polygonal ground near Dease Inlet. Note the details of the shoreline following the ice wedges. All polygons shown are of the "low-centred" type. 24 July 1950.

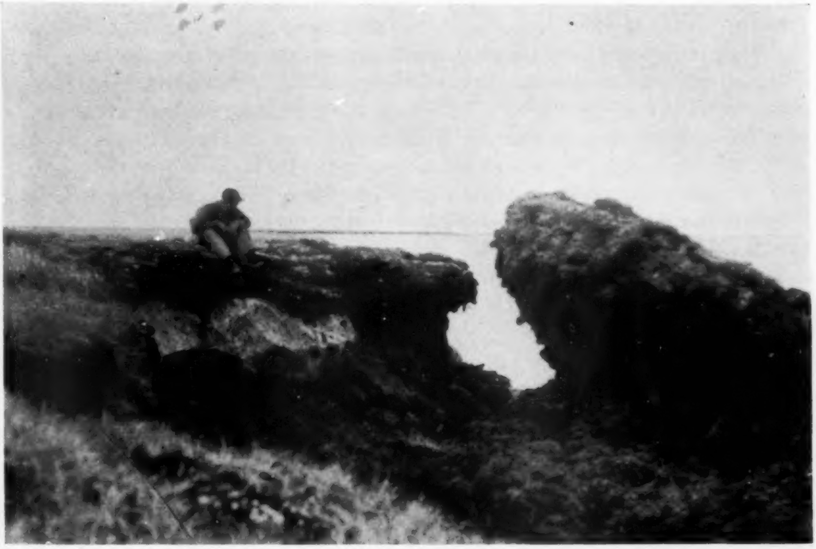

Fig. 5. Breakdown of bluff along ice wedges near triangulation station 'Goon'. Note ice exposed just beneath the seated figure.

lubricates the mass of unstable material. Polygonal ground, where at all well developed, creates a tendency for the cliff faces to break off along the lines of ice wedges that bound the polygons (Fig. 4), so that whole polygons, or large parts of them, fall as a unit, leaving nearly vertical walls of ice to mark their former positions. Figure 5 shows a breakdown of the bluff near triangulation station 'Goon'.

The effects of polygonal ground on cliff erosion are well illustrated in the low bluffs along the south shore of Elson Lagoon. Breakdown of these cliffs is controlled almost wholly by the presence of the vertical ice wedges that bound the soil polygons. After a part of the cliff breaks away along one of these wedges and falls to the beach, it disintegrates further and its materials are distributed by wave and current action.

The sand spit that connects Point Barrow with the mainland shows only the ordinary erosional processes at work. Although poorly developed soil polygons are present in the sand and gravel, they do not seem to influence shore processes to any appreciable extent. At the point itself sand and gravel bluffs about 15 or 16 feet high are rendered sufficiently coherent by interstitial ground ice to maintain vertical faces toward the beach. Slow melting of some of this interstitial ice in the face of the bluffs during the warmer months loosens the sand and gravel, which slump and gradually build up a talus slope that, after a protracted spell of warm weather not accompanied by storm waves, may almost completely conceal the face of the bluff. Occasionally a large block of the cliff face falls away and piles up on the beach, having split off along one of the ice wedges that bound the soil polygons back of the bluff. This material is removed from the beach by wave action during the next period of rough water, and the whole process is ready to repeat itself.

Nowhere could any direct erosion by sea ice be distinguished as such although at times the sea ice pushes well up on the beaches and, more rarely, completely over-rides them. The chief effect of the sea ice seems to be protective rather than destructive, since no wave or current action is possible while the ice still forms a firm mass along the beach, as it does for at least half of each year. Also, when a major ice shove occurs, as happens in this neighbourhood at least once in every 4 or 5 years,[1] it brings with it considerable quantities of sand and gravel, which are deposited when the ice melts, thus helping to build up the beach rather than to cut it back. Remnants of two such ice shoves, both of which occurred during the winter of 1949–50, were visible along the beaches in August 1951. At that time they existed in the form of low mounds of ice, up to 8 or 10 feet in height, completely mantled by sand and gravel except where wave erosion along their seaward side had exposed the underlying ice.

Floating ice, which is present even during the warmer months, also helps to protect the beaches from direct wave action, as it has a strong inhibiting effect on wave development; the waves expend a large proportion of their energy on this floating ice offshore, and are greatly reduced before reaching the beaches. Even when no floating ice can be seen from the shore the polar

[1]Information supplied by Mr. Tom Brower of Barrow.

pack may be only a few miles beyond the horizon, and the fetch of open water available for the development of waves is correspondingly reduced. All this tends to minimize effective wave action so that, judging from personal observations extending over three summers and from information gleaned from other people, it seems that only once or twice in any one summer is the wave development likely to be sufficient to produce much active surf along this coast.

Tidal effects in the neighbourhood of Barrow are almost non-existent; the average rise and fall of the tide at Barrow is only about 6 inches.[1] So feeble a tide seems to have no discernible effect on shoreline processes. Variations in barometric pressure and movements of the surface water in response to offshore and onshore winds have greater influence than the tides on the local sea level, but even these are insufficient to produce appreciable effects.

Elson Lagoon is not only very shallow, but it is also only 5 to 10 miles wide; and it is protected from ocean waves by the Plover Islands. These islands prevent the development of large storm waves in the lagoon. Moreover, because of its sheltered position, and perhaps also because of its shallowness, the lagoon freezes over earlier than the open ocean and the ice tends to persist longer in the spring. Yet some of the most striking evidence of rapid shoreline retreat was observed along the south shore of Elson Lagoon.

In view of these considerations, it seems certain that the observed rapid changes in shoreline configuration, particularly at such sites as 'Nuwuk' and along the low bluffs of the south shore of Elson Lagoon, are due not to a vigorous attack by the sea but rather to the presence of a great deal of ground ice, which renders the land particularly susceptible even to feeble attacks.

The chief rolé of waves and currents is not that of direct erosion except during rare summer storms. Yet, while almost completely ineffective throughout the greater part of each year, waves and currents are sufficiently active to remove the incoherent thawed material that slumps and accumulates at the foot of the bluffs, thus ensuring that fresh surfaces are repeatedly exposed to thawing action during the warmer months.

The observations recorded in this paper were made while the writer was at the Arctic Research Laboratory at Barrow engaged in a geothermal project sponsored jointly by the U.S. Geological Survey and the Office of Naval Research.

[1]*U.S. Coast Pilot*, 'Alaska', Pt. II, 5th (1947) ed., p. 594.

OBSERVATIONS ON FOOD CONSUMPTION AND PREFERENCE IN FOUR ALASKAN MAMMALS

Peter R. Morrison and William J. Teitz*

During the summer of 1950 a number of living specimens were collected during studies on temperature regulation in Alaskan mammals.[1] These animals were brought back to Wisconsin and maintained in captivity, a number being still alive more than two years after capture. Since an adequate diet is often essential for successful maintenance, some systematic observations on food preference in terms of kind and amount were carried out. Such studies may be indicative of the requirements and food preferences of the animals in nature.

The animals studied were the Alaskan ground squirrels, *Citellus parryii ablusus* (8) and *C. osgoodi* (2), the Dawson red-backed vole, *Clethrionomys rutilus dawsoni* (8), the Alaskan collared lemming, *Dicrostonyx rubricatus rubricatus* (2), and the pika, *Ochotona collaris* (1). Some details as to habitat, distribution, abundance, and mode of capture of these animals are described elsewhere (Strecker and Morrison, 1952; Strecker *et al.*, 1952).

The following observations were made in Madison during October and November, about two months after capture, during which time the weights of the animals were substantially constant, that is there was no steady gain or loss in body weight. The lemmings and the pika were kept in individual cages in a window well in the laboratory while the ground squirrels and the voles were caged in groups in an animal room. The temperature of the latter was always near 22°C while that of the window well averaged about 17°C but showed considerable diurnal variation with low values of 0°C being recorded on two cold nights. However, all animals were liberally supplied with bedding material so that the effective temperature variation was much less.

The animals were fed at 24-hour intervals (48-hour over Sunday) at which time the residual food was removed, weighed, and discarded. The different foodstuffs were kept in separate glass or porcelain dishes of appropriate size. Food that fell through the mesh floor was screened from the sawdust and weighed with the other residual food. Occasionally it was necessary to shake out cached food from the cotton waste bedding. Contamination with urine or feces presented no great problem since the animals tended to deposit excreta at a definite location in the cage, often in the water dish. Consumption values were calculated by the difference in weight of the residual food from that supplied at the beginning of the period. For wet

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[1]These studies were supported in part by contract between the University of Wisconsin and the Alaskan Air Command, Arctic Aeromedical Laboratory, Ladd Air Force Base, Fairbanks, Alaska and by research grant from the Wisconsin Alumni Research Foundation.

foods it was necessary to correct the residual weights for loss of moisture as indicated in Table 1. In comparing food consumption, values were adjusted for water content and energy content and these factors are shown in Table 1.

Table 1. The water content and estimated caloric equivalents for the several foodstuffs, and the moisture loss from unconsumed foods.

Food	*Dry Weight*[1] *%*	*Energy content*[2] *in kcal. gm.* *Dry*	*Wet*	*Evaporative loss*[3] *% 1 day*
Cabbage	8.5	3.0[4]	0.25	22
Grass	30	3.0[4]	0.9	58
Carrot tops	30	3.0[4]	0.9	(58)
Carrot	13.5	4.0[5]	0.54	15
Apple	11.0	4.0[5]	0.44	24
Sunflower seeds	90	5.0[6]	4.5	
Peanut butter	(90)	5.0[6]	4.5	
Rat chow	88	4.0[5]	3.5	
Rabbit chow	89	3.0[4]	2.7	
Hay	(89)	3.0[4]	2.7	
Corn	84	4.0[5]	3.4	

[1] Residual weight after drying chopped foodstuffs for 48 hours at 105°C.
[2] Estimated *metabolizable energy*, *i.e.* gross energy minus fecal, urinary, and (fermentation–gas) energy.
[3] Evaporative loss in control samples of wet food held on top of the animal cages for 24 hours. Average values for 3–4 determinations.
[4] Estimated from values for average cattle and rabbit rations (Brody, 1945) and representing *c.* 2/3 of the gross energy.
[5] These carbohydrate-containing "storage" tissues were considered substantially digestible and estimated as 90 per cent of the gross value for corn meal (4.4 kcal./gm.).
[6] These oil-containing "storage" tissues were estimated as 90 per cent of the gross value for soybeans (5.5 kcal./gm.).

Detailed food consumption for the pika and the lemmings is given in Fig. 1. This shows considerable day to day variation in quantity, ranging up to three-fold although usually much less, despite the continuous presence of

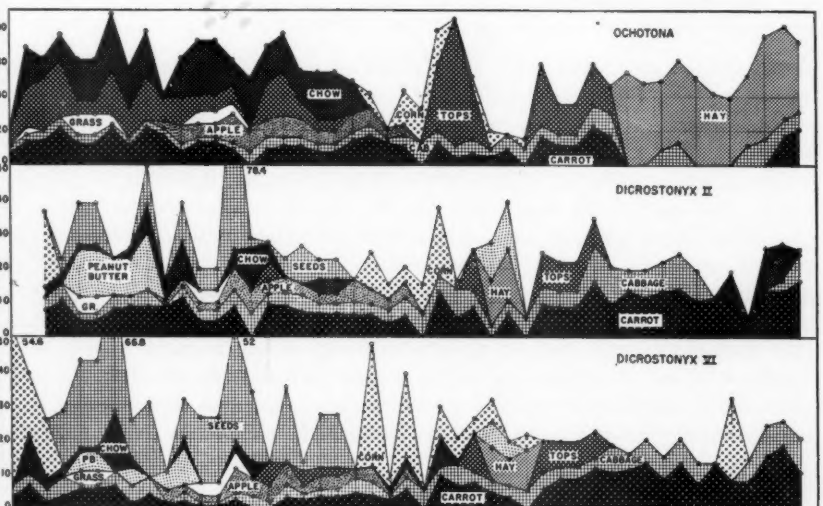

Fig. 1. Daily food consumption records for the pika and lemmings, as calories per animal-day (*cf.* Table 1). Wet foodstuffs below and dry above, represented by symbols. Consumption over the 48-hour Sunday period was allocated equally to the two days.

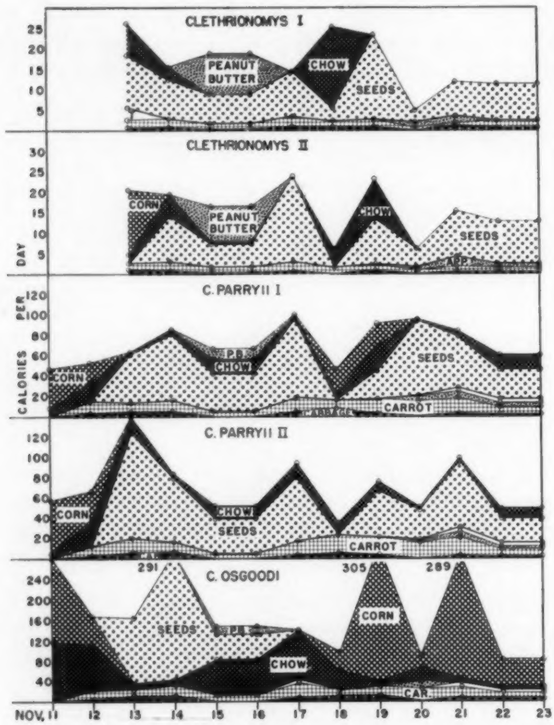

Fig. 2.
Daily food consumption records for ground squirrels and red-backed voles as cal./animal-day. Wet foodstuffs below and dry above, represented by symbols.

food. In almost all cases the excess or deficit from the average consumption rate is promptly made up during the next twenty-four hours. The period of these short cyclic fluctuations in food intake averaged 2.9 days. Possibly this behaviour, particularly marked in the lemmings, reflects a natural tendency to fill up when food is available together with a capacity sufficient to tide the animal over part of the succeeding day.

The daily fluctuations in food intake appear to be independent of the type of food supplied. Thus, in the lemmings the average total caloric consumption when given wet food alone (November 10–20) was the same as in other periods when half to two-thirds of the intake was in dry food. Similarly, the pika took in the same number of calories of hay alone (November 16–17 and 20–22) as it did when five different foods, wet and dry, were being consumed (October 11–30). The gross food intake varied with the type of foodstuff but the metabolizable caloric intake, as based on feeding values from domestic animals, was constant indicating that the caloric contents of all the foodstuffs supplied were equally available to these animals.

Water intake. The fluctuations in food intake were largely confined to the dry portion and when both food types were available the sum of the wet foods consumed was relatively constant. This was particularly evident in

the pika and the lemmings which were supplied a greater variety and which consumed larger amounts of wet foods than the squirrels and the voles (Fig. 2), and correlates with the observation that the former animals were never seen to drink nor to deplete their water supply. Such behaviour has previously been noted in the collared lemming by Degerbøl and Møhl-Hansen (1943).[1] The constant intake level of wet foods, then, may simply represent the water requirement of the animal rather than any specific preference or need. The average water intake through this route is summarized in Table 2. The values

Table 2. Food consumption for all groups as gross weight, calories, and water.

Animal or group		*Number*	*Av. Weight in gm.*	*Days*[1]	*Food consumption gm./gm.day wet food*	*gm./gm.day dry food*	*kcal./gm.day wet food*	*kcal./gm.day dry food*	*Ratio wet/dry food gm./gm.*	*cal./cal.*	*Water with food c.c./gm.day*
Clethrionomys	I	4	25	11	0.24	0.114	0.10	0.46	2.1	0.19	0.30
Clethrionomys	II	4	25	11	0.26	0.121	0.10	0.49	2.2	0.18	0.30
Dicrostonyx	II	1	38	33	0.70	0.128	0.28	0.48	5.4	0.52	1.01
Dicrostonyx	VI	1	47	31	0.71	0.078	0.29	0.29	9.1	0.86	0.90
Ochotona		1	127	33	0.55	0.073	0.25	0.18	7.5	1.3	0.60
C. parryii	I	4	482	13	0.068	0.027	0.031	0.11	2.5	0.25	0.08
C. parryii	II	4	419	12	0.087	0.029	0.042	0.12	3.0	0.32	0.08
C. osgoodi		2	683	12	0.086	0.046	0.038	0.14	1.9	0.24	0.11

[1]Only the days on which both wet and dry foods were given are included here.

for the lemming, 0.90–1.0 c.c./gm. day, are more than adequate to meet their water requirement. In contrast, the squirrels and the voles averaged only one-fifth of this value, 0.08–0.30 c.c./gm. day. They were observed to drink regularly, evidently obtaining their water from this source. The squirrels and the voles consumed only one-fifth of their calories as wet food while the lemmings and the pika took in roughly one-half.

Caloric intake. In general, the caloric food intake per unit of weight was greater in the small animals than in the large ones. This is in agreement with the general laws relating metabolic function and size. However, exceptions were noted in that the lemmings showed almost as high an intake per unit of weight as the voles which were only half their size. The melanistic *C. osgoodi* had a caloric intake roughly one-third higher than the two groups of *C. parryii* although the former were substantially heavier. Accordingly, it is of interest to compare the energy input (food consumption) with the energy output (metabolic rate) in these animals as shown in Table 3. The metabolic levels used here were calculated from the average rates of oxygen consumption at 20°C (Morrison, Ryser, and Morrison).

Both species of ground squirrels showed excellent correspondence between energy input and output with an average ratio of 1.01 (food/oxygen), despite the difference in consumption levels between the two. The agreement was not so close in the other species with the input running from 40 to 50 per cent above the output. This could well result from a higher activity level in the

[1]Collared lemmings kept in captivity in Ottawa have frequently been seen to drink, both from glass feeder tubes and from dishes, although liberally supplied with wet foods. *Ed. Arctic.*

Table 3. Comparison of caloric consumption and expenditure.

Animal or group		*Weight in gm.*	*Food kcal./gm. day*	*Oxygen*[1] *kcal./gm. day*	*Food/oxygen*
Clethrionomys	I	25	0.56	0.40	1.40
Clethrionomys	II	25	0.59	0.40	1.48
	Av.	*25*	*0.58*	*0.40*	*1.44*
Dicrostonyx	II	38	0.76	0.51	1.49
Dicrostonyx	VI	47	0.58	0.37	1.57
	Av.	*43*	*0.67*	*0.44*	*1.52*
Ochotona		127	0.43	0.31	1.39
C. parryii	I	482	0.141	0.138	1.02
C. parryii	II	419	0.162	0.156	1.04
C. osgoodi		683	0.178	0.185	0.96
	Av.	*497*	*0.157*	*0.155*	*1.01*

[1] Average rate of oxygen consumption at 20° C times 4.8 cal./c.c. The animals were confined in a small chamber which permitted moderate activity.

Table 4. Food preference ratios.

		WET FOODS					*DRY FOODS*				
		Carrot	*Cabbage*	*Grass*	*Carrot top*	*Apple*	*Peanut butter*	*Sunflower seed*	*Corn*	*Rat chow*	*Hay*
Clethrionomys	I	0.67	0.19			1.00		0.61		0.33	
Clethrionomys	II	0.59	0.23		1.0	0.88		0.68		0.47	
	Av.	*0.63*	*0.21*		*1.0*	*0.94*		*0.64*		*0.40*	
Dicrostonyx	II	0.22	1.00	0.25	0.27	0.36	0.39	1.00	0.44	0.17	0.55
Dicrostonyx	VI	1.00	0.67	0.77	0.67	0.42	1.00	0.67		0.45	0.83
	Av.	*0.61*	*0.84*	*0.51*	*0.47*	*0.39*	*0.70*	*0.84*	*0.44*	*0.31*	*0.69*
Ochotona		0.59	0.44	0.44	1.00	0.48	0.0		0.44	(0.5)	(1.0)
C. parryii	I							1.00	0.41	0.13	
C. parryii	II	1.00	0.22					1.00	0.45	0.19	
C. osgoodi								0.50	1.00	0.22	
	Av.							*0.90*	*0.55*	*0.19*	

cages than in the more restricted metabolic chambers. Indeed, the ground squirrels, which showed the closest agreement, also showed strikingly little activity in both cage and chamber, so that the excess in the other animals may reasonably be considered as the metabolic cost of activity. However, other factors, such as a loss of finely divided foodstuffs during feeding or a lower physiological availability (metabolizable energy), of the foodstuffs may have contributed to the discrepancy. In view of these several factors, all of which act in the direction of the observed discrepancy, the degree of correspondence is not unreasonable and shows that simple food consumption values can give a fairly reliable measure of metabolic requirements and output in wild animals.

Food preference. Discrimination in favour of one or another foodstuff was estimated separately for wet and dry foods in terms of a "preference ratio". For any given day the food consumed in greatest amount was given an

arbitrary value of 1.0 and the other foods were referred to this value in proportion to the number of calories consumed. Ratios for foods given separately on two days were estimated on the basis of a third common food.

These preferences, calculated separately for the wet and dry foods, are summarized in Table 4. The two groups of voles agreed closely with each other, and showed a definite preference for apple and for carrot tops of the wet foods and for peanut butter of the dry foods.

The two lemmings had entirely different preference values for all foods. This might perhaps be due to the fact that one was an adult and the other a growing young mammal, but it more probably reflects simply a lack of any preference in this species. This lack of preference is clearly seen since the average preference ratios range from 0.31 to 0.84 for the ten foods given, that is a fair amount of every food was consumed. Foods entirely unlike any they might encounter in nature were equally favoured as compared with more natural types. Such a catholic taste in foods would appear well adapted for survival in their rigorous natural environment.

The pika showed a similar diversity of taste in terms of the five wet foods, although carrot tops, which are probably most like the small plants which form their natural food, were preferred. Among the dry foods, hay, again the most similar to their natural food, was strongly preferred. Peanut butter was untouched and corn was eaten only sparingly.

The three groups of ground squirrels all agreed in their dislike for rat chow, one of the few common tastes shared by the four species. They differed in that the dark *C. osgoodi* had a decided preference for corn while the *C. parryii* preferred sunflower seeds.

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TWO PICTURES OF THE RECENT PAST

THE GENERAL CIRCULATION AT THE LAST (WÜRM) GLACIAL MAXIMUM. By H. C. Willett. *Geografiska Annaler, Vol. 32, Nos. 3-4 (1950) pp. 179-87.*

DIE VEGETATIONSZONEN DES NORDLICHEN EURASIENS WAHREND DER LETZTEN EISZEIT. By B. Frenzel and C. Troll. *Eiszeitalter und Gegenwart, Vol. 2 (1952) pp. 154-67.*

We cannot step backwards in time, which obstinately pursues its forward course. But in spite of this handicap, some of our contemporaries have made up their minds about the look of the world during the last glaciation. Three of them have recently published maps of that frigid epoch, and have written papers to explain their views. The first map, the work of Hurd C. Willett, shows what the climate was probably like; it is a map of pressure distribution, from which the skilled eye can reconstruct the prevailing weather of the northern hemisphere. The second comes from two distinguished German geographers, B. Frenzel and Carl Troll. It portrays the natural vegetation of Europe and Asia at the climax of the last glacial advance. I enjoyed super-imposing Willett's isobars on the Frenzel-Troll map, and have reproduced a small part of the combined result as Figure 1.

All three authors are modest in their claims. Willett (1950) says that his map is very tentative; he will be satisfied if it starts a discussion. He has been engaged for many years in a study of the general circulation of the atmosphere, more especially of its modern aberrations. Some of these aberrations seem to resemble conditions as they must have been in glacial epochs. Willett argues from these fluctuations of the modern climate back into the Pleistocene. He has drawn his map by a process of extended analogy, though he has been guided by far more than the analogy itself. The wisdom and experience of one of the foremost modern schools of meteorology has gone into this scientific dream, and it is entitled to respect and scrutiny.

Frenzel and Troll (1952) are equally diffident. They pay their respects to the work of Julius Büdel, who attempted a similar map for Europe only three years ago (1949), and to H. von Wissmann's (1938) well-known study of the Würm glaciation in China. They have acquired fresh data from the Soviet Union, an acquisition that makes possible a reliable map of vegetation from Atlantic to Pacific. The evidence upon which they drew comes mainly from the study of fossil pollen and plant fragments preserved in the peat-bogs, solifluction-deposits, and loess-layers of unglaciated Eurasia. They cite an impressive number of Russian sources, nearly all of which are quite recent.

I shall not question the validity of either map: clearly the devil's advocate is ruled out of court by the modesty of the papers' claims. Instead I shall ask this question: assuming that both maps are sound, and that they refer to the same moment in time, do they raise difficulties for one another when brought together?

I think they do; I believe that the climate shown by Willett ought to produce a distribution of vegetation different from the picture drawn by Frenzel and Troll. It is difficult, I must admit, to make the comparison direct enough for certainty. The Willett map refers to winter, whereas the climate of summer matters most in the study of vegetation. Nevertheless, Willett himself has given the clues by means of which we can visualize the summer climate. So we can proceed, bearing the difficulty in mind.

The difficulty starts in the Mediterranean, over which Willett shows a deep centre of low mean pressure, one of the most active of the cyclonic regions of the hemisphere. From this centre, he writes, ". . . storms probably travel either north and northeastward to feed the principal ice sheets, or more eastward, depending upon the fluctuating pattern of the general circulation". (1950 p. 182). He adds that in summer the storm tracks (and presumably the centre of low mean

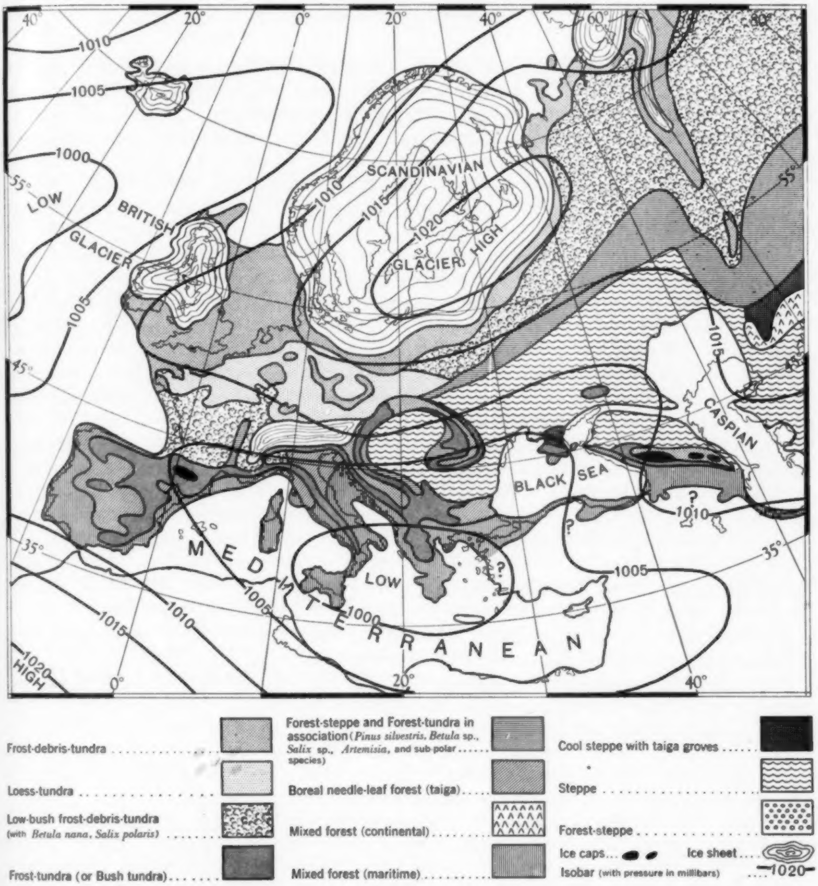

Fig. 1. Vegetation (after Frenzel and Troll) and winter pressure distribution (after Willett) at the climax of the last glaciation.

pressure) are shifted northwards towards the ice margin. This suggests that central and southern Europe, including the southern plains of Russia, were traversed in summer by eastward-moving cyclones, presumably with fairly warm, moist westerlies on their southern flanks. The cyclone tracks shown by Dorsey (in Flint, 1947, Plate 3) agree entirely with this view.

These facts imply an appreciable rainfall over the Mediterranean countries (which are now afflicted by a long summer drought) and over the plains of southern Russia. There is much evidence for such a pluvial period. We lack unequivocal proof that this humid epoch came at the climax of the last glaciation, though this is almost certain. The most striking evidence of the increased rainfall is offered by the lake levels in the numerous enclosed basins of the Mediterranean and Middle Eastern lands. Nearly all these basins show the unmistakable signs of high water levels; many that are now saline were fresh at some recent date, and possessed outlets to the sea.

Presumably this enhanced rainfall extended beyond the mountains of the Levant into central Asia, and ought, if we accept Willett's map, to have affected the Black,

Caspian, and Aral seas. There is plenty of evidence of high water levels from the Caspian, which had a brief connection with the Black Sea; the latter, moreover, was detached from the Mediterranean, draining to it via the Bosporus River. The Aral Sea covered an area one-third as great again as its present outline, and discharged for a long time to the Caspian through the Usboi (Flint, 1947, p. 477). Frenzel and Troll show a large expansion of the lake at the floor of the Tarim Basin. There is abundant evidence, in fact, that the pluvial regime extended far into the interior of Asia.

Yet the vegetation, if we accept the Frenzel-Troll evidence, remained droughty. The huge area of plains north of the Black Sea and the Caspian appear to have been covered by steppe; forest was confined to narrow galeria, that is strips along the rivers, and to a thin forest-steppe on the lower mountain slopes. We have this paradox: enough rainfall to create a large increase in run-off, and therefore high lake levels, but not enough to sustain forest. That the climate was warm enough for forest is hard to doubt. *Pinus silvestris* occurred in the combined forest-steppe/forest-tundra shown by Frenzel and Troll as running from the northern Ukraine in a broad belt through Gomel, Tula, and Kazan', well to the north of the region we are discussing. There seems to have been permafrost about as far south as the present Black Sea and Caspian north shores, but this would not have prevented forest growth: it does not do so today in Alaska, Mackenzie, and a large part of Siberia. Summer temperatures were probably between 50° and 55°F as far south as the 45th parallel, and possibly as high as 65°F in southern Turkistan. Very low rainfalls are adequate today to support coniferous forests at such temperatures. In the Mackenzie Valley an annual precipitation of 12 inches supports spruce forest on permafrost.

What, then, accounts for the treelessness of the steppes? We can suggest two hypotheses, and can quarrel with both of them:

(i) We might argue that the climate was in fact dry: that rain-shadow effects prevented the east-moving cyclones from producing heavy rain. The high level of the Caspian might have been due solely to the discharge of the Volga, carrying as it did much of the meltwater of the Scandinavian ice. But does this explain the prolonged expansion of the Aral Sea? Presumably this smaller lake was fed by the meltwaters from the expanded glaciers on the Hindu Kush. If these glaciers expanded, they could do so only with a substantial increase of snowfall from travelling cyclones, which again speaks for summer rain on the plains to the north.

(ii) Secondly, we could follow Carl Sauer (1952), and assert that a grassland climax is not a drought-indicator at all: he maintains that grasslands are confined to the plains of the world and reflect, perhaps, control by fire. The steppes of Russia in Würm days may have followed this pattern. Aurignacian hunters were living in the Crimea and the Ukraine, preying upon the subarctic mammals that roamed the steppes (Zeuner, 1950, p. 164). Did they use fire as a hunter's trap? And did they thus prevent the spread of trees? It seems unlikely: they were so few.

Probably the European students of the Pleistocene have an answer to this paradox: but it seems to need further discussion. I do not believe that a circulation like that depicted by Willett could give a climate dry enough in southern Russia for the survival of an open steppe. Yet the evidence of grassland cover, and even of loess accumulation, seems unshakable. Which view is right? F. KENNETH HARE

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INSTITUTE NEWS

Award of Institute research grants

The following have been awarded grants by the Institute for field work in the 1953 season:

Baird, Patrick D. The Arctic Institute, Montreal, Quebec, Canada.
Glaciological, geological, and biological investigations of the Penny Highland Ice Cap, Baffin Island.

Chapman, Lyman J. Ontario Research Foundation, Toronto, Ontario, Canada.
Evapotranspiration studies in northern Canada.

Cooch, F. Graham. Department of Conservation, Cornell University, Ithaca, New York, U.S.A.
Continuation of a study of the Blue Goose, its life history, management, and ecology.

de Laguna, Frederica A. Department of Sociology and Anthropology, Bryn Mawr College, Bryn Mawr, Pennsylvania, U.S.A.
Continuation of combined ethnographical and archaeological investigations at Yakutat, Alaska.

Drucker, Philip. Bureau of American Ethnology, Smithsonian Institution, Washington 25, D.C., U.S.A.
Modern inter-tribal organization in northwestern North America.

Fay, Francis H. Department of Zoology, University of British Columbia, Vancouver, B.C., Canada.
Continuation of a study of the life history of the Pacific walrus.

Friedmann, Karen J. 6406 31st Street N.W., Washington 15, D.C., U.S.A.
Current transition in Greenland's economy.

Gjaerevoll, Olav. Botanical Department, The Museum, Trondheim, Norway.
A floristic and phytosociological investigation of the White Mountains, Alaska.

Hammerich, Louis L. University of Copenhagen, Copenhagen, Denmark.
A study of the Eskimo of southwestern Alaska, especially with respect to dialectic frontiers between the Eskimo and the Aleuts.

Moir, David C. Department of Botany, North Dakota Agricultural College, Fargo, North Dakota, U.S.A.
Continuation of a floristic survey of northwestern Ontario.

Nutt, David C. Dartmouth College, Hanover, New Hampshire, U.S.A.
Winter oceanographic studies, southern Labrador.

Rogers, Edward S. Department of Anthropology, University of New Mexico, Albuquerque, New Mexico, U.S.A.
Linguistic and ethnographic study of the Mistassini Indians of northern Quebec.

Sailer, Reece I. U.S. National Museum, Washington 35, D.C., U.S.A.
Correlation of accumulated precipitation data with mosquito abundance in Alaska.

Scholander, Per F. Woods Hole Oceanographic Institution, Woods Hole, Massachusets, U.S.A.
An investigation of osmotic pressures in the blood of arctic and subarctic marine fishes.

Sperry, John D. Department of Anthropology, Columbia University, New York, N.Y., U.S.A.
A study of Yukon-Kuskokwim Eskimo social organization.

Sutton, George W. Department of Zoology, University of Oklahoma, Norman, Oklahoma, U.S.A.
Comprehensive study of the birds of the holarctic region (Baffin Island).

Wilkinson, Douglas E. Kirks Ferry, Quebec, Canada.
An experiment in social science among the Tununermiut Eskimo of north Baffin Island.

Wynne-Edwards, Vero C. Department of Natural History, Aberdeen University, Aberdeen, United Kingdom.
A study of the distribution and breeding biology of the sea birds of southern Baffin Island.

NORTHERN NEWS

First meeting of the committee appointed at the Canadian Eskimo Conference[1]

At the round table conference on Eskimo affairs held in Ottawa on May 19–20[2] a continuing committee was appointed to study the reports and suggestions presented. The members of this committee, which met for the first time in Ottawa on October 16 are: Major General H. A. Young, chairman, His Excellency J. Trocellier, Rt. Rev. Donald B. Marsh, R. H. Chesshire, Commissioner L. H. Nicholson, R.C.M.P., Dr. P. E. Moore, and J. G. Wright.

The Hon. Robert Winters, Minister of Resources and Development, addressed the committee and stressed the need for a practical approach to education to prepare the Eskimo for the changing times in the Arctic. There are at present seven schools for Eskimo in Canada and arrangements have already been made by the federal government to build an eight-room school at Aklavik.

The committee agreed that besides extending facilities for elementary education to all Eskimo children and building camp hostels at schools for those children who live away from the settlements, provision would have to be made for higher education and for technical training for those who showed particular aptitude. Eskimo who give evidence of possessing the necessary qualifications will be enabled to prepare themselves to work as teachers, nurses, or artisans, either among their own people or outside.

Consideration was also given to the problems involved in extending the medical care at present given to Eskimo, and particularly to the programme which has been in effect during recent years for the detection and treatment of tuberculosis. One of the more pressing problems is to provide convalescent or rehabilitation centres for Eskimo who have been discharged from hospital, but are not capable of returning to the rigorous northern life they have known before. Two such centres will be established in 1953: one at Frobisher Bay, southern Baffin Island, for Eskimo from the Eastern Arctic, and the other at Driftpile, Alberta, for the Western Arctic.

At the Frobisher Bay centre convalescent Eskimo will learn to take up their normal activities again. The Driftpile centre will be something of an experiment where it will be seen if those Eskimo who are unlikely ever to be fit enough to return to the north can adjust themselves to different occupations in areas other than the Arctic.

With the opening up of the North, which has followed the development of air travel, there have been a number of epidemics such as measles, scarlet fever, and whooping cough. In primitive times these were unknown among the Eskimo, and special medical measures are necessary. Ordinary health and medical problems are being met by frequent medical patrols, local hospitals, and nursing stations and by the voluntary work of missionaries, traders, and police throughout the country. Cases requiring specialized surgery or treatment are brought out by aircraft or boat to hospitals in the south.

The committee agreed that, under the direction of the Canadian Handicraft Guild, the development of handicrafts, as a source of Eskimo income has shown good results. Government assistance will be continued. Other small industries such as boat building, fishing for local markets, and the collection of eiderdown are to be encouraged.

[1]Reprinted from the *Arctic Circular*, Vol. 5, No. 6 (1952) pp. 63–4.

[2]See *Arctic*, Vol. 5, No. 3 (1952) pp. 193–5.

The naming of the walrus

Although walrus were known to western Europe during the Middle Ages, and indeed many of the medieval ivory carvings were of walrus ivory, knowledge

of the animal was limited and often confused. Consequently, it is not surprising that when arctic voyages from northwest Europe became common in the early sixteenth century, walrus were called by a variety of names; of these in English the commonest were walrus, morse, sea horse, sea cow, and sea morse. A recent study by V. Kiparsky ("L'histoire du morse", *Ann. Acad. Scien. Fenn.* Ser. B, Vol. 73 (1952) pp. 1-54) traces the evolution and relationship of the various names that have been given in European languages to walrus. He shows that most of the words may be traced back to the Lapp onomatopoeic word *morssa* derived from the grunting sound produced by the animals. That word was brought to western Europe, changing on the way to *hross*, with the addition of *hval* (whale) to *ros-hval* and eventually, with inversion, to walrus. The Basque whalers brought the Lapp word directly to Britain in the fifteenth century as morse. A similar form of the word, *mors*, reached central and western Europe by the sixteenth century by way of Finnish and Russian. J. Brian Bird

Anthropological Papers of the University of Alaska

The Department of Anthropology of the University of Alaska has recently published the first volume of a new series of *Anthropological Papers of the University of Alaska*. The first issue includes the following papers:

"Observations on the 'Eskimo type' of kinship and social structure" by J. L. Giddings, Jr.
"Notes on Koniag material culture" by Robert F. Heizer.
"The Aleut-Eskimo community" by W. S. Laughlin.
"The archaeology of Hooper Bay village, Alaska" by Wendell Oswalt.

The series will appear at irregular intervals and is to be devoted to arctic and subarctic anthropological studies. The first issue is priced at $1.50 per copy, including mailing, and can be obtained from the Department of Anthropology, University of Alaska, College, Alaska.

Letopis' Severa

Letopis' Severa is a Russian language periodical published by the Northern Sea Route Administration in Moscow and Leningrad, under the editorship of Professors Andreev, Vize, and Efimov. Volume I [or perhaps Number 1; only a large one appears on the title page] is dated 1949, and has 314 pages. It contains numerous articles by well-known Soviet scientists such as Vize, Okladnikov, and Mikhailov. Seventy pages are devoted to notices and reviews of new northern books and about 35 pages to short notes. I have seen only this single copy of *Letopis' Severa* and would be much interested in knowing whether other numbers reached this country.

Evelyn Stefansson

The discovery of ancient coins in Kamchatka

The following translation of S. I. Markov's account of "The discovery of ancient coins in Kamchatka" (*Letopis' Severa*, (*Chronicle of the North*), No. 1, 1949, p. 312-3) was made by Evelyn Stefansson.

Recently the collector-numismatist, K. I. Panin of Petropavlovsk on Kamchatka, told me of an unusual find which had been made in the deepest interior of Poluostrov Kamchatka (Kamchatka Peninsula), in a little known and uninhabited place.

In 1944 a worker at one of the local fish-breeding factories (*rybovodnykh zavodov*), O. I. Orekhov, found himself on the middle stream of the Kamchatka river, 200 kilometres from its mouth. On the shore of Ozero Ushki (Lake Ushki), which drains into the Kamchatka river, in the talus at the foot of one of its capes, which consists of a dense complex of rock strata, Orekhov came upon four small copper coins.

In 1948 Orekhov sent his finds to K. I. Panin. This experienced collector found himself unable to date the newfound coins, which were unlike any he had ever seen. He has written the following description of the coins:

Coin No. 1 (circular, with a diameter of 16 millimetres) has on one side a

representation of a bow with a taut bowstring, an arrow, and three letters. About two of the letters, A and N, there is no question, the third is similar to the Russian letter η, but with the first vertical stroke lengthened. The images are all in relief on a flat background. The reverse side has a prominent, humpy drawing which is indecipherable.

Coin No. 2 (circular with a diameter of 14 millimetres) appears to be an authentic fragment of some kind of Arabian (?) coin. On a portion of one side, what was probably the peripheral design of the original coin can be seen without difficulty. Another part shows interwoven Arabian signs. On the other side, placed asymmetrically, is a perfect circle containing symbols which may be numbers. The circle was apparently the centre of the original coin and has an ornamental border. All figures are in relief.

Coin No. 3 (circular with a diameter of 16 millimetres) is very similar to the preceding one in probable technical execution. It is so worn or flattened, however, that it is possible to make out only part of the Arabian (?) signs in its centre. The obverse side of the coin is completely effaced.

Coin No. 4 (circular with a diameter of 21 millimetres) unfortunately is also in an extremely unsatisfactory state of preservation. On each of its sides are different images of a head and profile in relief. No other trace of figure or symbol is visible. But astonishingly, when one takes the coin in one's hand and examines the profiles of the male heads, only one supposition comes to mind—this coin is either *ancient Greek or Roman.*

For clarification we were forced to turn to the expert numismatists of the Leningrad Hermitage. Preliminary examination of the coins gave striking results.

No. 1 appears to be a Greek coin of the Azov-Black Sea colony of Panticapaeum and dates from the third century before our era.

Coin No. 4 on Panin's list was minted about A.D. 17 in the Kingdom of Bosporus, also at Panticapaeum, which at that time was the capital of the Bosporus.

According to the conclusions of the specialists, one side of this coin portrays the king of the Bosporus, Rhescuporis I, and the other side the profile of the Roman Emperor (Tiberius?). In this connection it is well to remember that the king of the Bosporus had the title "friend of Caesar and friend of the Romans", and Bosporus coins usually bore the images of both the kings of the Bosporus and of the Roman Emperors. (See M. N. Tikhomirov and S. S. Dmitriyev, 'Istoriya S.S.S.R.' (History of the U.S.S.R.) Vol. 1, 1948, p. 15).

The other two coins are of eastern origin. One of them (No. 2) has been found to be a "pul" (1/32 of a silver "ten'gi") coined in Khorasan. The date of its minting has not been established.

It would be risky to speculate how these ancient coins from the shores of the Black Sea and from Central Asia reached the Far East of our country. But it is certainly worth noting that although far from any populated areas, they were on the track of the main water routes of Poluostrov Kamchatka.